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THE
GEOGRAPHICAL REVIEW

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FRIDTJOF NANSEN
1861–1930

John H. Finley

IN his address as Rector of St. Andrews University, Scotland, in 1926, Dr. Nansen pictured the Cro-Magnon man as of "magnificent stature," with a cranium holding one-sixth more brain than that of the modern European and showing the "beautiful arch of intelligence." And he wondered what such a noble physical creature of high intellectual capacity might have done had he had the education and knowledge of our day. But Nansen was himself as such a giant who had stepped out of another age—not the Cro-Magnon but the Viking age—into ours, so magnificent was he in stature, so massive of head, and so powerful of mind.

And he was the very incarnation of the soul of that which was the subject of his rectorial address in that remarkable St. Andrews series—with Kipling's and Barrie's and Grenfell's—, "adventure," which, as he interpreted and illustrated it, meant not following fitfully an irresponsible impulse or emotion but wanting to "see the end of things" and holding to his purpose at all hazards till the work he set his mind and hand to was done and done well.

It was that disciplined spirit of true adventure which called him away from the microscope of the anatomist to make the first crossing of ice-bound Greenland and then, in that forever famous Arctic voyage, to drift in the frozen-in *Fram* across the North Polar Sea in a prereckoned course from which, as he said, having set foot on the icy trail there was no possible retreat. He knew the risks when he burned his bridges behind him, but knowing these he was still ready to face them in the confidence of seeing the thing through. One reading this passage in that glorious geography of "Farthest North" will know that he had a reward beyond man's praise:

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> Nothing more wonderfully beautiful can exist than the Arctic night. It is dreamland, painted in the imagination's most delicate tints; it is color etherealized. One shade melts into the other, so that you cannot tell where one ends and the other begins, and yet they are all there. No forms—it is all faint, dreamy color music, a far-away, long-drawn-out melody on muted strings. Is not all life's beauty high, and delicate, and pure like this night? . . . Presently the aurora borealis shakes over the vault of heaven its veil of glittering silver—changing now to yellow, now to green, now to red. It spreads, it contracts again, in restless change; next it breaks into waving, many-folded bands of shining silver, over which shoot billows of glittering rays, and then the glory vanishes. Presently it shimmers in tongues of flame over the very zenith, and then again it shoots a bright ray right up from the horizon, until the whole melts away in the moonlight, and it is as though one heard the sigh of a departing spirit. Here and there are left a few waving streamers of light, vague as a foreboding—they are the dust from the aurora's glittering cloak. . . . And all the time this utter stillness, impressive as the symphony of infinitude.

I heard him tell the story of this voyage when he was fresh from the three years in the silences of the North and again after thirty years, and a more deeply stirring story of adventure I never heard. This brief passage explains all:

> Why did we continually return to the attack? There in the darkness and cold stood Helheim, where the death-goddess held her sway; there lay Nåstrand, the shore of corpses. Thither, where no living being could draw breath, thither troop after troop made its way. To what end? Was it to bring home the dead as did Hermod when he rode after Baldur? No! It was simply to satisfy man's thirst for knowledge. Nowhere, in truth, has knowledge been purchased at greater cost of privation and suffering. But the spirit of mankind will never rest till every spot of these regions has been trodden by the foot of man, till every enigma has been solved.

We hoped that he would go again up to the sea that should bear his name, though his praise will be forever on men's lips for what he did do, both as an explorer and geographer and as a lover of mankind in thought and deed. When he was last here, in the afternoon of his day, we did not dream that the darkness would come so soon. I quoted then some lines from the Poetic Edda, of which this was one:

> Give praise to the day at evening.

But, as I then said, we could safely praise his day long before its evening came. No lengthened Northern twilight could have added to his fame or subtracted aught from it. His day will be remembered not only by the evening but by the night. And not only will Northern skalds sing of his adventures in rune and epic, but peoples in the South whom he has helped in their misery will remember him gratefully as some Promethean Titan who sought to give them succor, as one who defied powers that seemed omnipotent, and who hoped till hope created "from its own wreck" the thing it contemplated.

THE ANTARCTIC CRUISE OF THE "DISCOVERY," 1929–1930

Sir Douglas Mawson

[With separate map, Pl. VI, facing p. 552]

FIG. 1—Proclamation Island, Enderby Land, seen from the deck of the *Discovery*.

OF all Antarctica's uncharted coast line the longest stretch is that between Gaussberg and Coats Land—over a hundred degrees of longitude. Landfalls in this section were made by sealing captains of the London firm of Enderby Brothers. Biscoe in 1831 sighted Enderby Land: Kemp two years later reported "appearance of land" some ten degrees or so east of Biscoe's position. In the century that has elapsed neither of the points nor any part of this coast has been seen again.

In 1911–1914 I had the good fortune to lead the Australasian Antarctic Expedition that had for its objective the exploration of that part of the Antarctic Continent lying to the southward of Australia. The westernmost sphere of our activities was Queen Mary Land and Kaiser Wilhelm II Land, where our results were tied in with those of Drygalski on the *Gauss* Expedition of 1901–1903. The desirability of continuing work in this sector has long been apparent,[1] and I readily accepted the invitation of the Australian government to lead an expedition there in 1929–1930.[2] From the three sponsoring governments it received the title of British-Australian-New Zealand Antarctic Research Expedition. The operations of the expedition during its first season have resulted in the closing of a considerable part of the gap east of Enderby Land. By ship and by airplane the coast has been outlined from about longitude 49° E. eastward to the 67th meridian, and the existence of land still farther to the east is indicated.

Captain Scott's old ship the *Discovery* lent on charter by the Falk-

[1] See for instance J. K. Davis: Future Exploration: The African Quadrant of Antarctica, *Rept. 16th Meeting Australasian Assn. for the Advancement of Sci., Wellington Meeting, 1923*, Wellington, 1924, pp. 488–492.

[2] Australian Expedition to the Antarctic. Statement by the Prime Minister, the Right Hon. S. M. Bruce. *Commonwealth of Australia Parliament 1929 [Publ.] No. 36*, Canberra, 1929.

land Islands government was outfitted in London. The vessel arrived at Cape Town on October 7 and was there given a final overhauling and coaled free of cost through the generosity of the government of the Union of South Africa. The scientific program commenced after departure from Cape Town, at which point most of the special staff[3] joined the vessel.

This was on October 19. After a stormy passage, usual in these latitudes, Possession Island of the Crozet group was reached on November 2. Anchor was dropped in American Bay, which is practically an open roadstead, and a landing effected.

Possession Island of the Crozets

Possession Island is the largest member of the Crozets. Its length is about fourteen miles and its breadth not much less. The highest peak rises about 5000 feet above sea level. The island group is entirely volcanic. Massive tuff beds and lava flows, dikes, and sills, all very basic, compose the bulk of the land. The active volcanic period was probably during the late Tertiary, and since then a glacial cycle has intervened. Even now snow lies thick on the ground a large part of the year and is a permanent feature of the high mountain tops. Many deep U-shaped valleys are cut through lava flows and ash beds alike, attesting to the former existence of permanent glaciers.

There is abundant vegetation on all the islands; but in variety it is confined to diminutive forms, there being no upstanding ligneous, treelike growth of any kind. The fleshy-leaved plant known as Kerguelen cabbage is the most imposing element of the flora.

On November 4 the anchor was raised and a line of soundings run. Special sights were taken and bearings of important points on the land were noted for the better charting of the islands. Then a course was directed to Kerguelen. Arrival was delayed by a gale when we were off the northeast coast, so that it was not until November 12 that the *Discovery* was safely moored to the jetty of the unoccupied whaling station at the port on Royal Sound known as Jeanne d'Arc.

Kerguelen, Land of Desolation

The primary reason of this call was to bunker the vessel from a depot of 400 tons of coal kindly transported to Jeanne d'Arc by the South African Whaling Company of Irvine & Johnston, who in such

[3] Including, in addition to myself in command, J. K. Davis, captain of the *Discovery* and second in command; Commander M. H. Moyes, R. A. N., survey officer; Professor T. Harvey Johnston, chief biologist; J. W. S. Marr, zoölogist and plankton specialist; R. A. Falla, ornithologist; H. O. Fletcher, assistant scientist; Dr. W. W. Ingram, medical officer and bacteriologist; R. G. Simmers, meteorologist and physicist; A. Howard, hydrologist and chemist; Flight Lieutenant S. Campbell, aviator and assistant scientist; Air Pilot E. Douglas, aviator and assistant scientist; J. F. Hurley, photographic artist; A. J. Williams, wireless operator. With officers and crew the ship's company totaled 39.

manner and in other ways greatly assisted our operations. It took nine days to effect the coaling, and during that time and the several subsequent days before departure south from Kerguelen we lost no opportunities for investigating the neighborhood.

Kerguelen Island has roughly the shape of a right-angled triangle

FIG. 2—The *Discovery* coaling at Port Jeanne d'Arc—an abandoned whaling station on Buenos Aires Channel, an arm of Royal Sound, Kerguelen. View looking west towards Swain's Haulover and the magnificent volcanic pile of Mt. Ross. (All the photographs illustrating this article are copyright by Frank Hurley. World copyright reserved. Reproduced by courtesy of the Hearst Newspapers.)

with the hypotenuse facing to the northeast. It measures about 90 miles in greatest length and aggregates some 2000 square miles in area. It is a land of remarkable fiords, of innumerable lakes and waterways, and of high mountains. Of the latter, Mt. Ross reaching about 7000 feet above sea level is apparently the highest. On its slopes and covering an extensive region to the southwest of the island are fine glaciers. There exists a considerable inland ice cap, and from it valley glaciers descend to the sea in places.

There is evidence that formerly the ice flood extended over the whole of the island—everywhere are ice-worn surfaces, moraine débris, and deeply entrenched fiord grooves. The past glaciation has been on an overwhelming scale, evidently chronologically concurrent with the Pleistocene glaciation so well recorded in the northern hemisphere.

On account of the prevailing high winds and fogs the weather

side of Kerguelen, which includes the west coast and the south coast, is comparatively little known. The east-facing coast on the other hand has been the locus of sealing activities for a hundred and fifty years past. There considerable low land exists which is densely covered with green vegetation similar in character to that of the Crozet group. Except for an area of granitic and other rocks, reported by former observers from the southwest of the island, the mass of the land is built up of an immense volcanic series, dominantly of basic character and comparatively recent in age. There are innumerable lava flows with intercalations of agglomerate and tuffs. Interbedded in this volcanic series are great thicknesses of fluvial boulder beds and thin seams of brown coal and marine late-Tertiary sediments. The coal is of little economic value. The character of the plant remains, which are suggestive of later Tertiary times, indicate warmer conditions than now prevailing.

Kerguelen is an extraordinarily interesting island; but wretched weather conditions and rugged topography preclude its economic development, and it remains a "Land of Desolation."

On November 24 a course was set for Heard Island, which lies in latitude 53° S. Every care had to be taken with navigation, for the vessel was laden with coal, even piled high upon the decks.

Heard Island

The high volcanic cone that constitutes the central feature of Heard Island hove in sight at dawn on the 26th. It was exceptionally clear weather, and a view was witnessed seldom revealed in that region of mist and snow. Even as it was, cloud hid a portion of the mountain so that it cannot be said with certainty whether there is still active emission of vapor from the crater. The report that such was the case in 1910 may be correct, but it may be that what was witnessed at that time was actually condensation cloud fraying out in wreaths from the 7000-foot summit.[4]

Anchor was cast in Corinthian Bay, open to the north and sheltered from the south, a poor place for a vessel to lie in but apparently the best offering for a craft of our size. A party of the scientific staff proceeded ashore by motor boat.

A run of four miles along the coast brought us to Atlas Cove, a snug harbor for very small craft. Here, owing to the advent of heavy weather, we spent five days marooned ashore. Though it blew hard and rained or snowed most of the time, a great deal was accomplished. The rocks are all volcanic and very similar in type to those of Kerguelen. A feature met with on Macquarie Island many years ago during the operations of the Australasian Antarctic Expedition of

[4] Compare the note "Heard Island" in this number of the *Geographical Review*.—Edit. Note

FIG. 3

FIG. 4

FIG. 3—Aerial view of the head of the glacier-covered Bras de Bossière, an arm of Royal Sound. Note the 1000-foot-high cliff wall in the left foreground and the high-level lakes cascading to the sea.

FIG. 4—A typical Kerguelen landscape, showing the effects of recent ice erosion on a grand scale. An aerial view looking west from Observatory Bay in the foreground over the site of the British Transit of Venus station of 1874. Here also the German *Gauss* Antarctic expedition of 1902 left a wintering party to carry on magnetic and meteorological observations.

1911–1914 was again noted here on Heard Island—the occurrence of lumps of indurated globigerina ooze caught up in and brought to the surface by the volcanic series.

The island is some twenty-five miles in length and about ten miles in breadth. The western portion was accessible to us from Atlas Cove, but steep icefalls rendered communication with the eastern end impracticable. Some fine glaciers descend from the heights to the sea, transporting in their short course an enormous load of débris including erratic blocks of gigantic dimensions.

FIG. 5—Atlas Cove on the northwest coast of Heard Island.

Though a considerable part of the island is under snow and permanent ice there is much vegetation. In range of species it is much more restricted than that of Kerguelen. Amongst the herbage there are harbored varieties of wingless insects, which peculiar forms are a notable feature at Kerguelen and the Crozet Islands. The evolution of such forms on these oceanic islands is truly remarkable.

THE KERGUELEN-HEARD ISLAND-GAUSSBERG RISE

At great hazard the last of the shore party were reëmbarked on December 3, and in a strong gale the *Discovery* managed to creep out into the safety of the high sea. A course was set somewhat east of south with the intention of reaching the pack ice in the neighborhood

of the eightieth meridian; at the same time we hoped to define the farther extension of the Kerguelen-Heard Island rise.

The *Gauss* Expedition had shown the existence of colder bottom water in the eastern division than in the western division of the South Indian Ocean. The inference was that a rise exists in the ocean floor between Heard Island and Gaussberg. The actuality of such a rise was suggested by a 1260-fathom (2304 m.) sounding recorded by the *Challenger* in a position roughly intermediate between these positions. It was not surprising, therefore, to find day after day as we progressed, that considerably shallower water existed along this course than recorded by previous expeditions in the ocean to the east and to the west. Excitement, however, waxed daily when not only was the rise discovered to be much more marked than heretofore had been suggested but that the water became shallower as the ship progressed southward. Eventually at 6 p. m. on December 7 in latitude 59° 10′ S. and longitude 77° 45′ E. the bottom was found to approach within 350 fathoms of the surface. Thereafter the depth increased, but the ridge may continue eastward of our course, from this time on nearly due south. We left the ridge with reluctance and with the intention, unfortunately not realized, of renewing the investigation on our return.

Into the Pack Ice

A few small icebergs had been seen in the neighborhood of the Crozet group but none since then until the afternoon of December 7, when five were seen from the crow's nest. The following day as we traveled south many large bergs came into view, mostly tabular. By noon bergs were quite numerous and bars of ice blink in the sky indicated increasing ice ahead. This proved to be the case, for by noon on the 9th in latitude 61° 36′ S. and longitude 77° 59′ E. the sea was found to be studded with bergs and fragments of very old bay ice. Here the depth was 1783 fathoms (3261 m.). Typical summer pack-ice weather prevailed now, namely high barometer with light breezes only and subdued ocean swell. On December 10 the noon position was latitude 62° 36′ S. and longitude 78° 22′ E. The sea was much encumbered with ice but left sufficient room for the ship to work satisfactorily to the south. Though large bergs up to 80 feet in height were not uncommon, the bulk of the obstructions were in the nature of rafts of one-year-old sea ice packed in belts ranging in length from half a mile to two miles in length. In the afternoon there was much of last winter's pack in the form of cemented jumbled ice rafts. During the last two days the sub-Antarctic bird life had given way to Antarctic types, such as snow petrels and Antarctic petrels. Antarctic types of penguin and seal appeared on the floes, and nettings recorded typical Antarctic marine fauna.

The ice was more closely packed along our course on December 11, so much so that at times it was doubtful whether it would be possible to push farther south. There was a noticeable abundance of bergs of a type shed from the coast margin of ice-capped land. The low rafts were uniformly composed of a "gravestone" type, a jumbled

FIG. 6—The *Discovery* finds close pack ice where the *Challenger* met with open water fifty-eight years ago.

mass of highly inclined tablets of winter floe that has been smashed by storms and pressure.

On the 12th the ship made slow and difficult progress through the ice; and on the 13th with snow falling and a moderately cold blizzard wind blowing, evidently from land to the southeast, the vessel became firmly embedded (65° 5′ S., 81° 1′ E.). Late on the 15th, with an improvement in the weather, Captain Davis managed to push the ship out into an open lead, which we were able to follow southwest to latitude 65° 41′ S. where it ended in unbroken, heavy pack. It was estimated that the land probably lay not far to the south; but, as the airplane was not ready for flight, the ship's head was turned northwards to attempt a penetration of the pack zone farther to the west.

At this time all hands were busy unpacking the Moth airplane which, for lack of space and proper housing, had been carried from London as deck cargo in the original packing cases. The limited space and adverse weather delayed the work; and, when all was ready, weather and ice conditions proved unpropitious. It was not possible to make a flight until the last day of the year; but from that time on the airplane, as a scout, proved a great boon.

Proximity of Land Suggested

In an effort to work to the west the ship was driven north to latitude 64° 31′ S. in longitude 77° 41′ E. at noon on the 17th. There the depth was found to be 1850 fathoms (3384 m.). Thereafter it was possible gradually to work the ship south through a sea thickly

Fig. 7—A decadent berg, derelict on the submerged moraine off the Enderby Land coast, as seen from 1000 feet in the air. Originally a typical Antarctic tabular berg, old age has caused shrinkage in the upper less compressed layers, developing a remarkable structure not heretofore recorded.

strewn with heavy pack. To add to the difficulties a blizzard arose, which persisted for several days, finally abating late on Christmas Day when the ship had 648 fathoms (1185 m.) of water beneath her in latitude 66° 28′ S. and longitude 73° 28′ E. The following day solid, unbroken, hummocky floe ice was met in latitude 66° 57′ S. and longitude 71° 57′ E. Thus was farther progress to the south effectually barred. The depth of the water here was 258 fathoms (472 m.). During the cold midnight hours there appeared, miraged up on the horizon beyond the floe ice, what looked like the rising slopes of ice-covered land. Across the floe came the cold outflow of continental air. Here, evidently, we were near the land, separated by an interval of unbroken floe ice. Dredgings brought up quantities of erratics carried out by bergs. Without exception all were continental in type, actually very similar to those of Queen Mary Land. Granite and acid gneisses predominated. This evidence is strongly indicative of a continuation of the coast line of the Antarctic Continent at least thus far to the west. If not part of the continent, then perhaps we were lying adjacent to a continental island mass standing upon the continental platform separated from the mainland merely by a continental sea.

No more time could be given to further investigation of this area, and again the ship's head was turned north with the object of pressing to the west as opportunity offered.

New Land Seen from the Plane

At noon on December 29 the position was latitude 65° 6′ S. and longitude 67° 53′ E. This retreat to the north was followed by a deepening of the sea to 1428 fathoms (2612 m.). It was still heavily decked with ice, but slow progress to the south and west now became possible. Amongst the pack was noted a large piece of beach ice with abundant sand still adhering to it. On the morning of the 31st we were prevented from farther southerly progress by continuous solid, hummocky floe ice. From the crow's nest it was noted to continue to the south as far as the eye could reach. The day was fine and clear, so that the range of visibility was great. The ship's position was then latitude 66° 10′ S. and longitude 65° 10′ E. Under the keel was a depth of 1462 fathoms (2674 m.), interpreted as a location on continental slopes but still some considerable distance from land.

Conditions being favorable, the airplane was swung over the side of the ship on its floats, and an ascent was made by Campbell and Douglas. To the south nothing was to be seen but continuous solid ice until a height of 2500 feet had been reached. Then there loomed up a dark line of water beyond the hummocky floe. At 5000 feet the strip of open water, separated from the ship by a belt some forty to forty-five miles wide of practically unbroken ice, appeared to be about ten miles wide and led beyond to undulating ice-covered land. Embedded in it were numerous large icebergs, and away to the southwest were the projecting black tips of what were apparently several small islands. These islands of course accounted for the hold-up of the old pack, which was prevented from drifting past them to the west with the current. They were named Douglas Islands.

After remaining aloft for an hour or more the plane descended to report. It was then late in the day, and so it was decided to steam slowly west along the edge of the fast ice with the expectation of making a further ascent on the morrow. Unfortunately, however, a wind arose, and several days were spent in weathering a gale and dodging massive ice rafts.

At noon on January 2 the ship's position was latitude 65° 21′ S. and longitude 64° 45′ E. On every side were immense flat-topped rafts of very old floe ice rising fifteen to twenty feet above the water. Quite obviously this had recently broken out from a sheltered location along some coast line. Such a change in the nature of the floating ice was heartening.

Though a strong wind was still blowing, rapid progress to the

FIG. 8

FIG. 9

FIG. 8—Berg and floe off the coast of Kemp Land, brilliant in the fine weather.

FIG. 9—An aerial view across the ice field to Proclamation Island, Enderby Land. See also Figure 11.

south was now being made, and the depth of the water decreased with every mile in that direction. On January 4 in latitude 66° 35′ S. and longitude 61° 17′ E. denser pack was met, halting farther progress to the south. A sounding showed the depth to be 550 fathoms (1006 m.), but it was later discovered that the bottom in that neighborhood is subject to rapid changes in depth within short distances.

Whilst waiting for the wind to abate, land ice slopes were miraged up on the southern horizon during the evening hours. On the 5th, as the weather was favorable for flying, the opportunity was taken to examine the new land from the air. With Campbell as pilot, I ascended to 4000 feet in about 61° E., then flew a few miles east and west and towards the land, which presented a magnificent spectacle from the air. East, west, and south high ice-covered land extended to the horizon. Peaks were observed to break through the general surface at intervals, but in the main it is an ice plateau that rises steadily to the south. The coast line was distant from the ship not more than thirty miles. First came a belt of some fifteen miles of pack ice, then a few miles of free water, and finally six to ten miles of hummocky floe frozen solidly to the land. Seventy or eighty miles to the west we could see dark peaks looming through the distant haze.

One of the most pleasing observations was the discovery that to the west of us lay comparatively open sea. Evidently we had arrived at the western limit of the great pack belt through which the *Discovery* had pushed her way for a month past.

It was decided to move the vessel slowly to the west during the evening hours with the expectation of next day reaching the actual coast in that direction. The weather was then beautifully calm; but soon after midnight there was a sudden change, and a violent wind from the east arose. All the following day we were hove to in what Captain Davis and I agreed was, while it lasted, the most severe summer hurricane we had experienced in Antarctic seas. The instruments recorded a wind velocity of over seventy miles an hour. Fortunately, the most violent phase abated after a day of great anxiety, but the gale and thick weather still continued for some days. It was not until January 11 that the ship could be headed back towards the newly discovered coast. It was found, however, that the recent hurricane had set the pack from the east down upon this section of coast, so we had to turn the vessel to the west with the intention of following the coast line in that direction.

Kemp Land

At noon on January 12 we were off an ice-cliff coast in latitude 66° 3′ S. and longitude 57° 43′ E. The peaked ice slopes of the land lay only a few miles to the south. A sounding gave 146 fathoms (267 m.). Throughout that day the ship had been following the well

defined edge of the pack and occasionally passing through lines of grounded bergs. The distribution of the banks upon which these bergs were grounded suggests that they represent submerged moraines.

Kemp had come in sight of land in this vicinity in the year 1833, but the exact position of his landfall has been in doubt because he had with him only two chronometers neither of which pursued an even rate.

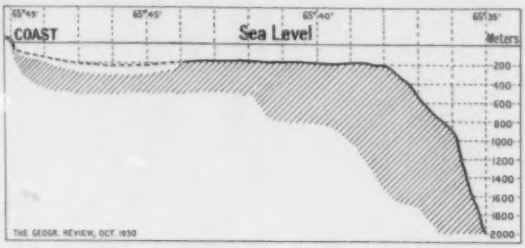


FIG. 10—Section across the continental shelf on longitude 54° 25′ off the coast of Enderby Land at latitude 65° 49′ S. The vertical scale is exaggerated five times.

The weather was fine, and we continued west along the coast ice cliffs. The sea was everywhere very free from ice except for scattered bergs, most of which were aground, and for a belt of brash pack from one to three miles wide which clung to the coast itself, working slowly west under the influence of the east-to-west coastal current.

PROCLAMATION ISLAND

On the morning of January 13 the *Discovery* arrived at a striking feature of the coast which we subsequently named Proclamation Island. A peaked, black, rocky island, reaching a height of 800 feet (244 m.), stands on the coast margin, evidently joined to the mainland by a thick ice shelf during much of the year but separated in summer by a water channel several hundred yards in width. There are many other tiny islets in the neighborhood, and rocky prominences also project from under the land-ice sheet. The islets give shelter for vessels against moving pack ice and create the best approach to an accessible harbor anywhere noted along these coasts.

The neighborhood was examined by some of the scientific staff whilst a party ascended to the top of the peaked islet. On this most unusual feature of the coast so far seen we raised the Union Jack. From this elevation a better view was obtained of the mainland. A number of rocky peaks were seen to rise above the ice plateau. A bold peak to the southwest of Proclamation Island corresponded closely in position with that named Mt. Codrington by Biscoe. We ascertained its height to be about 4870 feet (1485 m.). Evidence that glacial conditions are waning thereabouts was noted in the fact that this island rock mass is everywhere grooved and polished by former ice and has, dumped upon it even to the summit, a veneer of erratics obviously transported from the mainland to the south.

The ship continued west along the coast line separated from the

FIG. 11—An aerial view of Proclamation Island, Enderby Land. On the right is a lobe of the ice continent where the ice cap meets the sea. View looking east. Here is seen the most northerly cape of Enderby Land.

seen the most northerly cape of Enderby Land. On the right is a lobe of the ice continent where the ice cap meets the sea. View looking east. Here is

FIG. 12—Enderby Land seen across the intervening narrow pack belt. The high rock mass on the coast on the left is Mt. Biscoe (1600 feet altitude). Other nunataks rise through the ice plateau in the distance.

hundred-feet-high ice cliffs by only two or three miles of loose pack ice. The undulating ice surface penetrated by sharp, rocky peaks rose to the interior seemingly to an altitude of some 2000 or 3000 feet. A well defined continental shelf extends out to sea for fifteen to twenty-five miles, then the sea floor plunges to the ocean depths (Fig. 10). Considerable areas of the continental shelf range from one hundred to one hundred and fifty fathoms in depth. At intervals lines of grounded bergs recur, usually in from one hundred to one hundred and thirty fathoms of water.

Throughout the 14th a course was maintained along the pack edge which hugged the coast and stretched away to the west-southwest. The width of this pack varied from five miles to many miles in width. The ice fragments were tightly packed together under the influence of an ocean swell rolling in from the northwest and north, which also accounted for the pulverization of the marginal zone to the state of brash.

The Scott Mountains

A conspicuous black rocky mountain in latitude 66° 13′ S. and longitude 51° 25′ E. we named Mt. Biscoe. It rises steeply from the sea front to a height of 1600 feet. Most of the northerly face is encrusted with guano, for countless flocks of Antarctic petrels and other sea birds resort there during the nesting season. Farther south and west the pack belt widens, apparently held up by grounded bergs and ice tongues extending from the land. Thus edged away from the coast, our view of the land became limited to the higher portions only. A fine range of rocky mountains extending from the coast to the east roughly along the 67th parallel we named the Scott Mountains, to commemorate the great contribution to Antarctic exploration made by Captain Robert Falcon Scott. What appeared to be the farthest inland extension of this range visible from the ship is a high and very notable peak which we have named Mt. Riiser-Larsen, the estimated height of which is 6100 feet (1860 m.).

Meeting with the "Norvegia"

During the evening of January 14 whilst we were steaming west along the edge of the pack ice in about longitude 47° E. and latitude 66° 22′ S., just out of sight of land, the Norwegian exploring vessel *Norvegia* hove in sight coming towards us from the west. The celebrated explorer and aviator, Captain Riiser-Larsen, was on board. He honored the *Discovery* by paying us a visit. An hour was spent exchanging views and roughly outlining our respective programs. We explained that the region for the investigation of which our expedition had been equipped lay east of the fortieth meridian of

east longitude. A farthest west marine station was conducted about the forty-fifth meridian. We then turned back to the east on January 15, leaving the more westerly field of operations to the Norwegians. On January 16 we passed the *Norvegia* some ten miles distant heading to the west.

We had planned to make a flight over the pack towards the Scott Mountains for their better delineation. Fate was against us, however, for whilst we were waiting for a diminution in the ocean swell for a safe take-off a strong gale arose. For two days Captain Davis was able to maintain the ship in her position (66° 11′ S., 49° 33′ E.), but eventually the force of the wind and the drift of the ice were so great that the *Discovery* could hold on no longer and was driven 150 miles to the west-southwest. There the ship was hove to in a big sea.

The Return Voyage

On the morning of January 22 the sky cleared sufficiently to allow sights to be taken, and progress was begun in retracing our steps to the east. The result of the gale had been to push the pack edge several miles farther south. Thus, as we retraced our steps east along the edge of the pack, we were able to sight land farther to the west than was possible on our earlier course. Land ice was sighted in 46° E., 66° 40′ S., and again an imposing shelf-ice tongue bounded by cliffs upwards of two hundred feet in height came within sight over the pack in 66° 22′ S. and 48° 31′ E.

From the vicinity of Proclamation Island, reached on January 24, several short scouting flights to an elevation of 5000 feet were made. They revealed numbers of rock peaks strung out in lines across the ice plateau, representing the unsubmerged summits of mountain ranges. The ice plateau was observed to rise steadily to the south, reaching elevations of about 5000 feet (1500 m.), whilst still higher rose sharp peaks, some of which were judged to so far exceed the elevation of the plane that they must be quite 7000 feet in height.

The coal remaining in the bunkers was now thought to have reached the minimum necessary for the safe return of the vessel. Consequently, on the evening of January 26, at the height of the Antarctic season, we were reluctantly forced to turn north. We directed a course to Kerguelen, where further coal was to be obtained. The island was reached on February 8, between which date and February 20, while coaling and scaling of boilers were being completed, members of the scientific staff were engaged in biological and geological investigations, as well as the filling in of gaps in the existing chart of the region. The aviators made several flights. Hurley accompanied them and obtained many fine views illustrating the striking topography of the island.

Though it was too late in the season for us to contemplate further operations in the pack ice zone, we had intended to proceed south from Kerguelen for further investigation of Heard Island and the submarine ridge extending southeast therefrom. Unfortunately, the weather broke late in February, a series of gales descending upon the region. When we left Kerguelen on March 2 we reluctantly decided to proceed direct to the southwest corner of Australia. Along this route it was found possible to conduct full marine stations at regular intervals, and the last weeks of the cruise were occupied in executing this valuable work. The *Discovery* arrived off Albany with this section completed on March 21 and, after running a line of soundings across the Great Australian Bight, arrived in Adelaide on April 1.

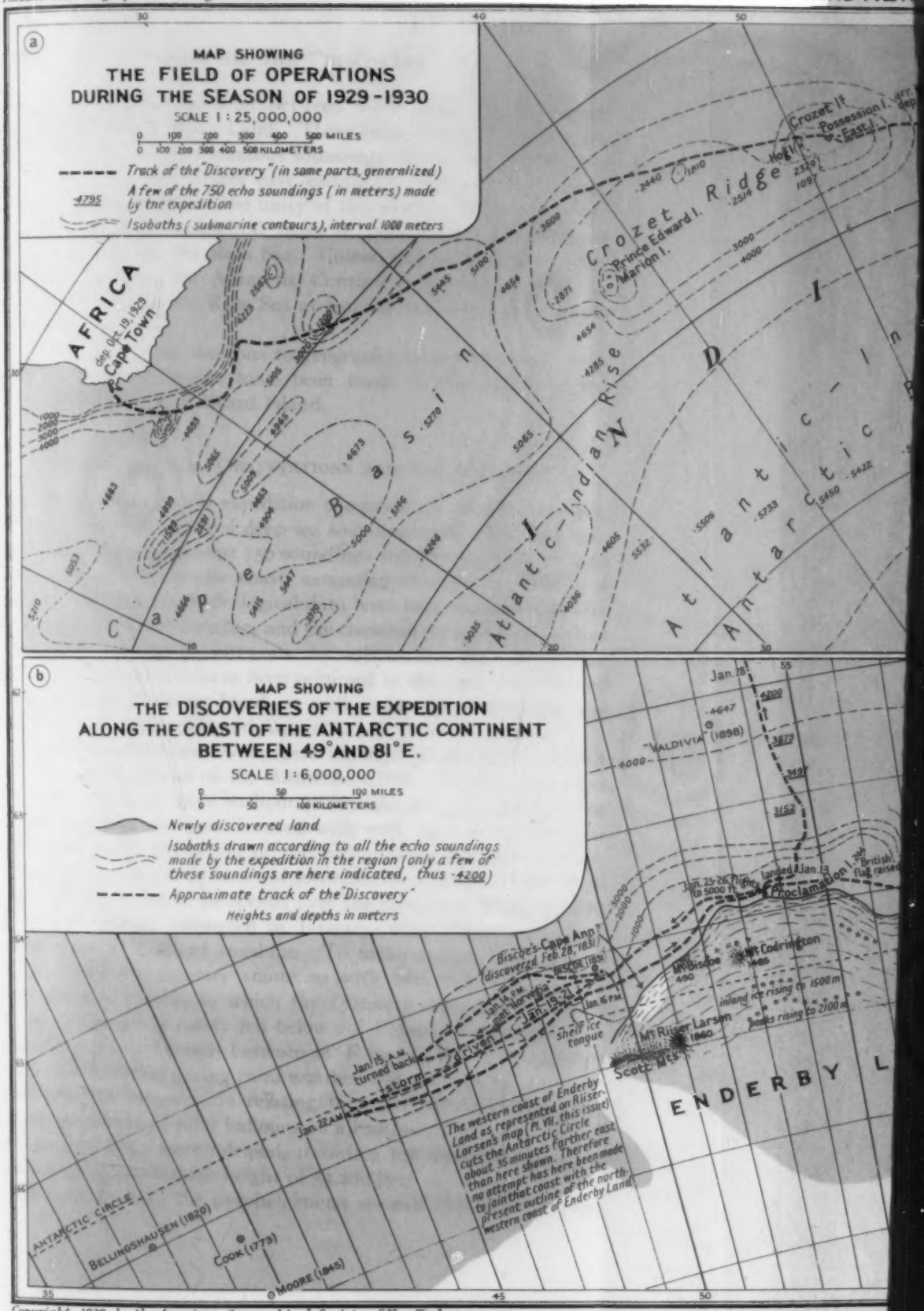
Enderby, Kemp, and MacRobertson Lands

The newly discovered and newly examined territory we have mapped in three divisions. That extending between the 45th and the 55th meridian[5] is defined as Enderby Land, for this was the sphere of Biscoe's operations in 1831; that between the 55th and 60th meridian is indicated as Kemp Land, for Kemp sighted land in this interval in the year 1833. Kemp's landfall was not so reliable in longitude as Biscoe's. If we accept one of his chronometers, the land he saw would be in the eastern half of this interval. If it should prove that his other chronometer was the correct one, then his landfall would be nearer the 55th meridian.

We are certain, however, that no previous explorer saw land to the east of the 60th meridian; consequently the new land that we have charted in that direction has been named MacRobertson Land, to commemorate the outstanding help afforded to the expedition's finances by Mr. Macpherson Robertson of Melbourne. All is high, ice-covered land rather similar in topographic character to the well known Queen Mary Land but with an ice plateau studded far more freely with nunataks. In the neighborhood of Proclamation Island, as viewed from the airplane at an elevation of 5000 feet, upwards of a hundred peaks are visible rising through the general ice flood. Along the seacoast, however, exposures of rock are few, the land ice terminating, with rare exceptions, in a vertical ice wall from sixty to a hundred and fifty feet in height.

The rocks, where examined *in situ*, and all erratics dredged from the sea floor in these coastal waters are uniformly continental in type. Granites, diorites, gabbros, schists, and metamorphosed quartzites and slates are the varieties thus met. There is exhibited a great

[5] As a result of Riiser-Larsen's delineation of a north-south coast in 50° E. (Pl. VII) and of Mawson's delineation of a northwesterly trending coast in 58° E. (Pl. VI) a 250-mile-wide projecting land mass emerges on the map to which, as a natural unit, it seems advisable to attach a single name. "Enderby Land" has hence been applied to this extension on Plate VI.—Edit. Note.


a
MAP SHOWING
THE FIELD OF OPERATIONS
DURING THE SEASON OF 1929-1930
SCALE 1 : 25,000,000
0 100 200 300 400 500 MILES
0 100 200 300 400 500 KILOMETERS
Track of the "Discovery" (in some parts, generalized)
4795 A few of the 750 echo soundings (in meters) made by the expedition
Isobaths (submarine contours), interval 1000 meters
AFRICA
dep. Oct. 19, 1929
Cape Town
Crozet Basin
Crozet
Prince Edward I.
Marion I.
Crozet I.s
Possession I.
East I.
Atlantic-Indian Rise
Indian
Atlantic-Antarctic
Antarctic
b
MAP SHOWING
THE DISCOVERIES OF THE EXPEDITION
ALONG THE COAST OF THE ANTARCTIC CONTINENT
BETWEEN 49° AND 81° E.
SCALE 1 : 6,000,000
0 50 100 MILES
0 50 100 KILOMETERS
Newly discovered land
Isobaths drawn according to all the echo soundings made by the expedition in the region (only a few of these soundings are here indicated, thus 4200)
Approximate track of the "Discovery"
Heights and depths in meters
Jan. 28
"VALDIVIA" (1898)
Landed Jan. 13
Proclamation I.
British flag raised
Jan. 25-26 Rise to 5000 ft.
Biscoe's Cape Ann discovered Feb. 28, 1831
BISCOE (1831)
Jan. 14 P.M. met Norvegia
Jan. 19-21
Jan. 16 P.M.
Shelf ice tongue
Mt. Biscoe
Mt. Codrington
Inland ice rising to 1500 m
Peaks rising to 2100 m
Mt. Riiser-Larsen
Scott Mts.
Jan. 15, A.M. turned back by storm
Jan. 22 A.M.
The western coast of Enderby Land as represented on Riiser-Larsen's map (Pl. VII, this issue) cuts the Antarctic Circle about 35 minutes farther east than here shown. Therefore no attempt has here been made to join that coast with the present outline of the north-western coast of Enderby Land.
ENDERBY L
ANTARCTIC CIRCLE
BELLINGSHAUSEN (1820)
COOK (1773)
MOORE (1845)

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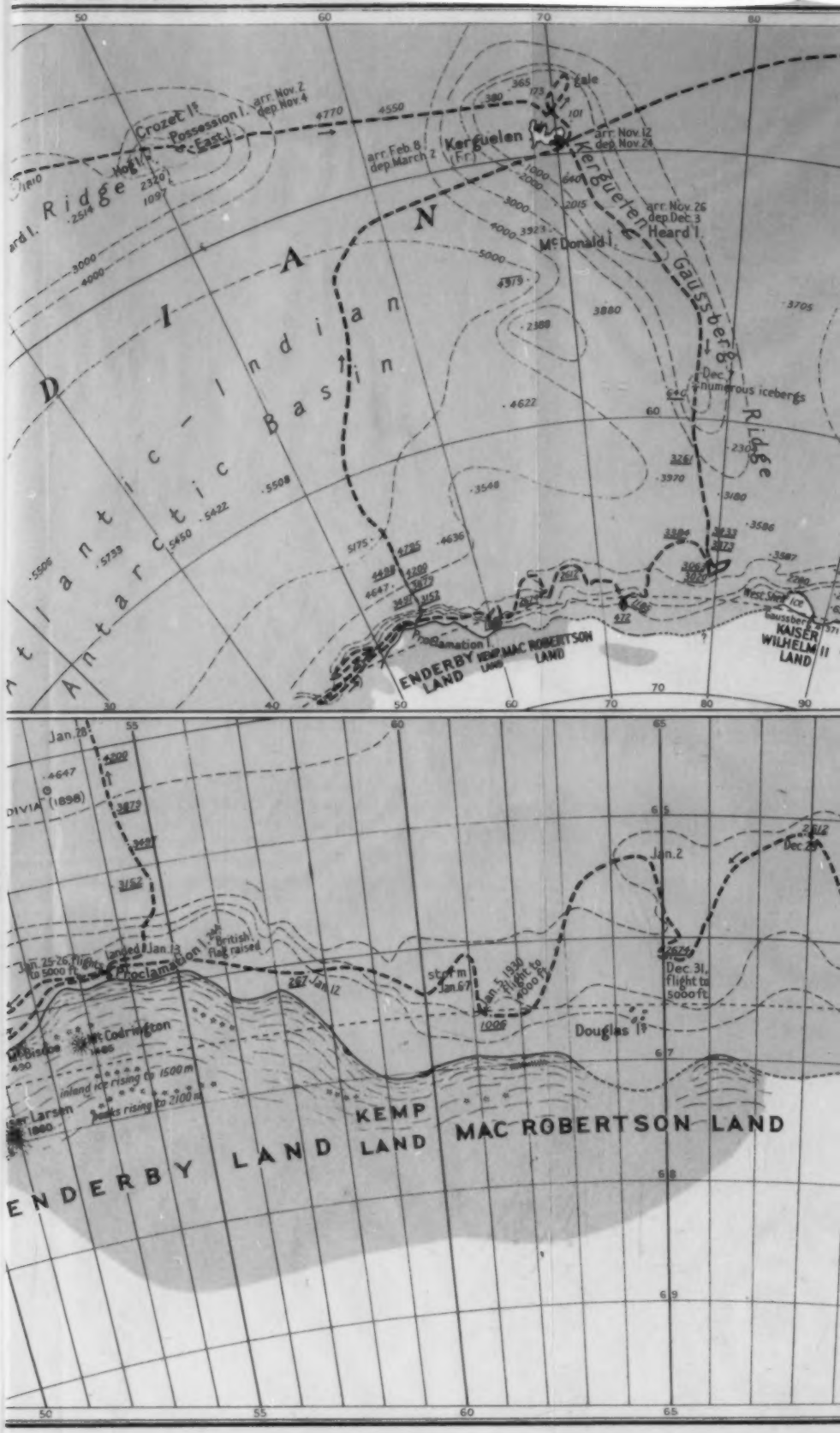
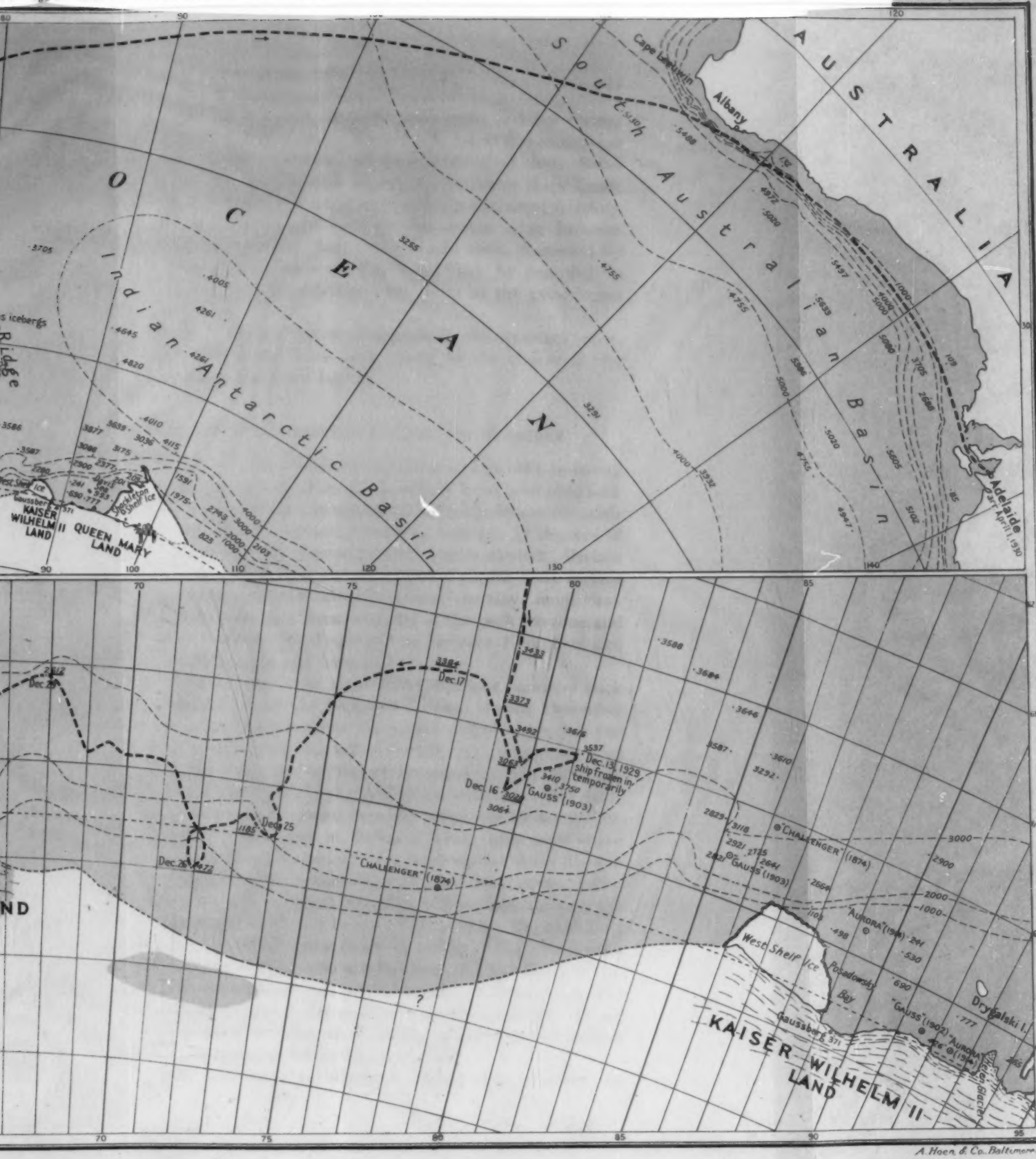

Crozet Is.
Possession I.
East I.
arr. Nov 2
dep Nov 4
Hog I.
Kerguelen (Fr.)
arr. Feb. 8
dep March 2
Gale
arr. Nov 12
dep Nov 24
Kerguelen
Heard I.
arr. Nov 26
dep Dec 3
Mc Donald I.
Gaussberg
Dec. 7 numerous icebergs
Ridge
Ridge
Atlantic-Indian Basin
Antarctic
INDIAN
Proclamation I.
ENDERBY LAND
KEMP LAND
MAC ROBERTSON LAND
KAISER WILHELM II LAND
West Steep Ice
Gaussberg
DIVIA (1898)
Jan. 28
Jan. 25-26 flights to 5000 ft
landed Jan 13
British flag raised
Proclamation I.
Jan. 12
Storm Jan. 6-7
Jan. 5 1930 flight to 4000 ft
Jan. 2
Dec. 31 flight to 5000 ft
Dec. 28
Douglas I?
Mt Codrington
Mt Biscoe
Mt Larsen
inland ice rising to 1500 m
peaks rising to 2100 m
ENDERBY LAND
KEMP LAND
MAC ROBERTSON LAND



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similarity in general character between these rocks and our former collections in Queen Mary Land. These facts, taken in conjunction with an analysis of the numerous soundings effected off these shores and in the region still farther east leading on to Queen Mary Land, are all strongly in favor of the unity of this newly examined territory with the accepted continental mass of Antarctica lying between these longitudes and the Ross Sea. Unless, and until, disproved by future explorations, the Antarctic Continent may be regarded as extending west from the Ross Sea at least as far as the 45th degree of east longitude.

In addition to contributions to geography in the Antarctic zone, corrections and extensions have been made to the charts of the Crozets, Kerguelen, and Heard Island.

Oceanographical Observations and the Weather

By the inclusion in the expedition equipment of an echo-sounding machine, a valuable series of deep-sea soundings have been obtained. These amount in all to about 750 soundings and include a series made in waters off the Antarctic coast, extending through 35 degrees of longitude. Exhaustive hydrological data have been secured. Besides observations of the temperature and the chemical nature of the surface waters taken at regular intervals throughout the day, more than twenty vertical stations have been occupied in the pack ice zone and northward from Enderby Land, as well as between Kerguelen and Antarctica, and Kerguelen and Australia.

December and January were spent amongst a vast region of pack ice in the neighborhood of the Antarctic Circle. During December there were only four days without snow, and out of a possible 700 hours of sunshine we were favored with only 75. Even this does not give an exact indication of the monotonous amount of cloud, inasmuch as, out of the 75 hours of sunshine. 60 occurred on five days, leaving only 15 hours to be spread over the remaining 26 days. The weather was greatly improved in January, when there were many cloudless days of brilliant sunshine. To make up for these days of sunshine, however, January smote us with two very severe gales. During the two months in which the *Discovery* cruised through the pack the temperature rarely fell below 25° F. and for the most part remained remarkably steady between 28° F. and 31° F. The minimum temperature recorded during calm weather was only 20° F.

Considerable information relating to upper air movements was obtained by release of pilot balloons on all suitable occasions. In all, 34 of these balloons were released, recording the direction of motion of the air up to an extreme height of 53,200 feet.

Observations with the pyroheliometer showed that, with the sun

at the same height in the sky in the two places, the Antarctic air let through 50 per cent more heat than that of the Australian Bight. No doubt the presence of dust particles in the Australian air partly accounted for this difference. Experiments with a "jet dust counter" revealed no trace of dust in the Antarctic air.

Life in the New Region

Of all the scientific work conducted on the expedition, that relating to the biological sciences was the most extensive. All life in this new region is obviously of great interest not only to abstract science but to economics.

The sub-Antarctic islands visited are amongst the most noted existing sanctuaries of marine bird life. The feathered population of these islands have many features in common with those of Bouvet Island and South Georgia. It is quite otherwise with the bird life of the new Antarctic lands visited, for there the affinity is with that of the Antarctic coasts to the east and unlike the American Antarctic Archipelago to the west. The sheathbills, or "paddies," of South Georgia extend to Kerguelen and Heard Island but are unknown at Macquarie Island. The ring penguins of the South Orkney Islands are not seen on the coasts of Enderby Land or anywhere eastward to the Ross Sea.

Examination of the plankton content of the seas traversed was one of the most carefully and systematically conducted parts of the work. Observations were quantitative as well as qualitative. Nets were operated at a large number of stations, which gave information as to the kinds and numbers of organisms occurring in the waters between depths of 1000 and 750 meters, 750 and 500, 500 and 250, 250 and 100, 100 and 50, and 50 to the surface. Other nets were towed obliquely from a depth of 100 meters to the surface behind the ship for a known distance at a known speed, so that an average cross section of the life of the more superficial waters was thus obtained. For larger organisms a net with much greater diameter and a wider mesh was used. These were operated at depths of over a mile below the surface. For obtaining examples of the living bottom forms, trawls were employed. Some of the hauls on the Antarctic continental shelf were extraordinarily rich.

Crab-eater seals were everywhere distributed through the pack ice but in no sort of concentration. Occasionally sea leopards and Ross seals were seen basking on the pack. A few Weddell seals only were met with close to the Antarctic shores. A notable whaling ground was found to exist in the seas off the coast of Enderby Land, especially to the west thereof.

THE "NORVEGIA" ANTARCTIC EXPEDITION OF 1929–1930

Hjalmar Riiser-Larsen

[With separate map, Pl. VII, facing p. 572]

IN 1926 Consul Lars Christensen of Sandefjord, a leader in the whaling industry, initiated a seasonal program of Antarctic exploration.[1] It began with the voyage of the *Odd I* to Peter I Island, 1926–1927. The following season the *Norvegia* was sent into the field. Bouvet Island was explored and annexed for Norway. Unfortunately the damage sustained when the ship struck a rock curtailed the program, which had called for an attempt to reach Enderby Land. The next year the *Norvegia* carried out investigations in the waters westward to Peter I Island, and that island also was occupied for Norway.

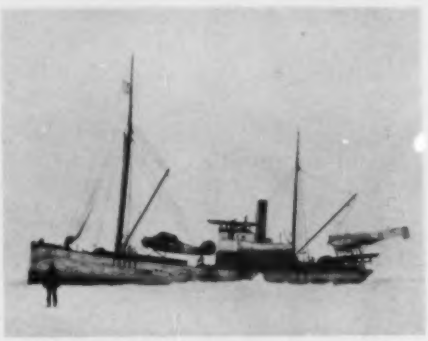


FIG. 1—The *Norvegia* awaiting the opening up of the ice near Enderby Land.

For 1929–1930 a more extensive program was laid out, and Consul Lars Christensen offered me the leadership of the expedition. Aerial reconnaissance was to be an essential part of the expedition; and Commander Lützow-Holm, a well known pilot of the Norwegian Naval Air Service and my comrade on many flights, offered to come with me.

The airplanes and all other equipment[2] were transported to

[1] Cf. Gunnar Isachsen: Modern Norwegian Whaling in the Antarctic, *Geogr. Rev.*, Vol. 19, 1929, pp. 387–403.

Reference to the field work of 1926–1929 is to be found in "Brief History of Polar Exploration Since the Introduction of Flying," *Amer. Geogr. Soc., Special Publ. No. 11*, 1930, p. 17.

Bjarne Aagaard: Antarctic Whaling and Exploration, *Scottish Geogr. Mag.*, Vol. 45, 1929, pp. 23–34 and 65–81. Mr. Aagaard also has in press a comprehensive work "Fangst og Forskning i Sydishavet" (Whaling and Scientific Research in the Antarctic) with a map showing routes of expeditions, 1 : 37,000,000. From him I received most valuable assistance in my study of the Antarctic before leaving Norway.

[2] We had to take into consideration the very small room for planes on board the little 114-feet-long *Norvegia*. A careful study of the question led us to buy a Lockheed Vega monoplane fitted with skis and floats. The latter were necessary for the handling of the machine in the Antarctic, and they also made the Lockheed serviceable as a spare plane for the seaplane. The second machine, a naval reconnaissance type, was lent us by the navy. The remaining equipment, based on my experience from three previous expeditions, included a Goerz sun compass, a Goerz speed and drift finder, a Hughes bubble sextant, skis, sledges, airplane boat, tents, guns, sledging provisions, etc.

the Antarctic on one of Mr. Christensen's whaling factories, the *Thorshammer*. The *Norvegia*, which had been laid up at South Georgia during the southern winter of 1929, first proceeded to Bouvet Island for the purpose of establishing a shelter and provision depot for shipwrecked mariners and then met the *Thorshammer* at a point west of that island, when the airplanes and equipment were trans-

FIG. 2—The *Norvegia* in the iceberg harbor at Bouvet Island.

ferred. After a number of flights carried out in conjunction with the whaling operations conducted from the larger vessel, we finally started on our own expedition on November 8. The total personnel of the expedition was eighteen, and the crowded ship had a comical appearance with the planes towering over everything—the Lockheed with the high wings on the low midship deck, the seaplane with the low wings on the high quarter-deck. We experienced the same difficulty that confronts all expeditions using coal burners—the question of bunkering. To gain our goal we had to say goodbye to Plimsoll's mark and load the ship down to the deck, a condition which naturally handicapped us in other ways as we had to keep close to the ice for shelter during the frequent gales.

BOUVET ISLAND MAPPED

Following the ice we again proceeded to Bouvet Island, which we sighted on November 11. The pack ice had receded a considerable

distance south of the island during the few days subsequent to the *Norvegia's* earlier visit. We were eager to find smooth water to take off the seaplane for the purpose of mapping the island. And in this we were eminently successful, for innumerable huge icebergs of the plateau type stranded on the west coast of the island enclosed the most perfect seadrome one could wish. During our stay here several flights were made and a series of oblique pictures of the coast line taken, the low clouds not permitting us to get high enough for vertical pictures.

Another hut with provisions was erected on Lars Island,[3] the little island off the southwest corner of Bouvet, and moving pictures were taken of the animal life—penguins, fur seals, sea leopards, sea elephants, and the like—in which the island abounds. Our work here finished, we set out for our next goal—Enderby Land.

Course Set to Enderby Land

As everyone knows, Enderby Land was discovered by that very able

FIG. 3

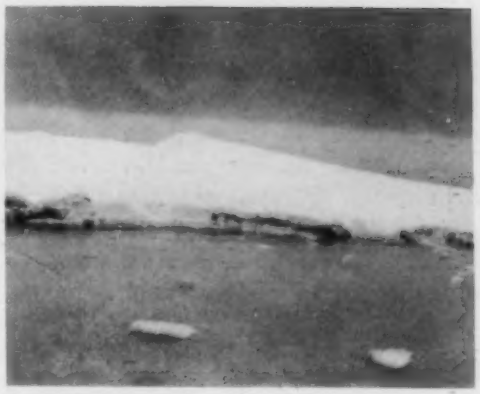


FIG. 4

FIG. 5

FIG. 3—Lars Island off the southwestern coast of Bouvet Island.

FIG. 4—Bouvet Island from the south.

FIG. 5—The north coast of Bouvet Island.

[3] See the chart of Bouvet Island by Harald Horntvedt based on the 1927–1928 *Norvegia* expedition, Oslo, 1928. Scale 1:50,000.

FIG. 6—Adélie penguin on nest, Bouvet Island.

British seaman, Captain Biscoe, in 1831. Later expeditions that tried to get there failed. To accomplish our program we had to reach Enderby Land early in the season, but at that time a direct approach would be impossible. Penetration of heavy pack for several hundreds of miles was out of the question. I had already learned in the Arctic not to work against the ice but with it.

I had in mind von Neumayer's theory[4] of a warm current setting towards Enderby Land, the southward bending of the isotherms here, and the fact that no icebergs are found towards Kerguelen. In the vicinity of Enderby Land the ice drifts in a westerly direction. Should we approach it from the western side we should have to work against wind and ice, and if caught in the ice should drift in the wrong direction. Furthermore, with the prevailing easterly winds the leads and openings in the ice have a north-south trend. Pushing into the ice southeastwards would mean working through heavy pack with little advantage of the leads, whereas cutting into the ice to the east of 53° E. would enable us to take full advantage of the leads. Then again there was the record of the German Deep Sea Expedition on the *Valdivia*, which as early as December 16 (1898) found a huge bay in the pack ice at about 53° E. with open water as far south as 64° 14′.[5] We decided to follow the edge of the ice eastwards searching for this "Valdivia Bay," as we called it.

PACK ICE AND ICEBERGS

We left Bouvet Island on November 14, encountering a number of gales while under way, during the worst of which we had to seek shelter in the ice. Soundings were taken with a Behm echo sounder. At about 24° E. (in about latitude 56° S.) there was a change in the water; its color turned blue, and new kinds of birds appeared.

Comparing the wake of the icebergs drifting through the pack with the direction of the wind, interesting observations were made. "Drift" is not quite the right expression to apply to an iceberg. The pack drifts with the wind at a certain speed, which we later found to

[4] Die Erforschung des Süd-Polar-Gebietes, *Zeitschr. Gesell. für Erdkunde zu Berlin*, Vol. 7, 1872, pp. 120–170, with map on a scale of 1 : 40,000,000. On some subsequent observations and views see references in Krümmel: Handbuch der Ozeanographie, Vol. 2, 1911, p. 680.—EDIT. NOTE.

[5] Wissenschaftliche Ergebnisse der Deutschen Tiefsee-expedition, 1898–1899, Vol. 1, Atlas, Pl. 39.

be about twenty miles a day; the bergs, however, which lie deep in the water—some bergs to 1000 feet and more—follow the current and are affected comparatively little by the winds. The rate of movement of icebergs farther south we found to be ten miles a day. It will readily be appreciated that an iceberg sailing through the pack with a speed of about ten miles a day against the wind constitutes a great danger for ships that are fast in the ice—a danger further accentuated by the frequency of fog and snow squalls that hide the bergs.

FIG. 7—Baby sea elephant on the beach of Bouvet Island. It has melted down through the ice thereby finding perfect shelter from the blizzard.

Here also we found icebergs that had melted down to the last nucleus, an ice which probably had once been frozen in very muddy water and had the color of black rock. Such ice also was so compact and heavy that it hardly moved in the swells. In fact, the swells broke over it as over a rock. Once we were compelled to go very close up to one of them to make sure that it was ice and not rock.

On November 25 at about 40° E. the edge of the pack turned south, a course we followed until the 27th, when it took a northerly direction again. It was rather hard to resist the temptation to seek a short cut to Enderby Land, but we adhered to our chosen plan, proceeding along the edge of the ice until November 30 and then following leads in the pack eastwards. We passed the meridian of 53° close south of latitude 60° but to our disappointment found no "Valdivia Bay." At 55° E. on December 1 we were stopped by heavy ice. A strong gale was blowing from the south, which took us northwards with the ice until the next day. The only consolation we had was that the direction of the wind would open up the water to the south.

Then, when everything seemed at its worst and I was in the crow's nest awaiting the clearing of a snow squall, a huge blue whale came up blowing in the patch of water in which we lay and proceeded southwards at a great rate. That meant open water to the south, and our spirits rose. The following day brought us into great lakes of water, and we made good progress.

To save coal we now tried using seal blubber with it and with very good result. I did not like to kill seals for this purpose, but in our case it seemed necessary, and at least as regards the sea leopard I had no bad conscience, for I had learned what a terror it is to penguins and crab-eaters. I had studied seals in the Arctic, and it was interest-

ing to compare their habits with those in the Antarctic. The enemy of the Arctic seal is the polar bear, which kills his prey on the ice. When the Arctic seal is scared by man he leaves the ice immediately, seeking safety in the water. The Antarctic seal,[6] however, has nothing to fear on the ice but knows that the sea leopard will hunt him when

FIG. 8—The ice breaking up off Enderby Land.

he gets into the water. And so when scared by the approach of ship or man he does not take to the water but stays on the ice groaning; or, if he gets into the water, he hides under the ice where his light color protects him.

One often reads that the sea leopard before killing a penguin plays with it like a cat with a rat. I do not think this statement is true, except perhaps in the case of young leopards, but refers rather to the way they eat their prey. As the penguin dives the leopard seizes it and comes up to the surface with it in his mouth. Since he cannot hold the penguin with his flappers he takes a good bite, throws his head with a quick jerk from one side to the other to tear off the part of the bird he is biting, while the rest is thrown a few yards away. Then, having devoured the first piece, he quickly picks up the bird and repeats the performance.

On December 5 we again encountered heavy ice and passed a big tabular berg at least fifteen miles long. In the early evening we got out into open water, not a lead nor a small lake, but a veritable sea. The open water lasted until 8 o'clock the next morning, and we

[6] Four species of seals are found in the Antarctic—the crab-eater, Weddell seal, Ross seal, and the sea leopard.

worked the ship into a bay at the head of which we were brought up against unbroken pack, the heaviest ice we saw during the whole season, an ice that could be compared with Arctic ice. Our position was 64° 21′ S. and 53° 14′ E. To get farther south with the ship was out of the question: we waited better visibility to make a flight.

FIG. 9—Heavy pack which stopped the *Norvegia* off Enderby Land on December 6, 1929. Picture taken at midnight.

AIR RECONNAISSANCE SHOWS LAND TO THE SOUTH

A southerly breeze brought bright and clear weather on the morning of December 7. Shortly before 11 o'clock Commander Lützow-Holm and I were in the air with the seaplane to reconnoiter ice conditions to the eastwards. As we approached the altitude of 3000 feet I saw two black spots far away to the south. They might be the shadow side of icebergs, but they might also be nunataks. At 4000 feet I was sure that the black spots were mountains. I wrote down the message "Land to the south" and handed it to Commander Lützow-Holm. He had seen it himself too and pointed in the same direction. We flew towards it some forty miles; but, as there was a stiff wind against us and the distance to the land was too great to enable us to get there and back again with safety, we returned to search southwestwards, where I believed the ice would be opened up by the Neumayer Current. Before turning we took a good view of the land. It stretched out to the west and east of the cliffs first seen. Far to the east what seemed to be a mountain range protruded through the ice, and several nunataks were observed far inland where the inland ice gradually sloped to the south; others were observed to the

west. We passed the ship and flew for an hour southwestward. As I expected, great openings were seen in the ice in this direction; but quite heavy pack drifted between them and the bay in which our ship lay. After having taken several bearings we returned.

On this flight we experienced how immensely difficult it is to find a ship in the ice. What you look down upon is not a huge white plain: the ice is broken, some cakes drift loosely, some are closely packed; the picture indeed, in black and white and in colors from the diatoms, is the most irregular that could be dreamt of. Moreover, if one is away any length of time ice conditions may have completely altered before one gets back, on which account it is advisable to leave the ship for long flights only when weather conditions indicate that no fog or snow is likely to occur before the return.

When we had got the machine on board again we pushed off to the west to try to reach the water openings, but the ice barring the way would not allow us to pass through. Weather conditions changed for the worse—gale after gale and snow squall upon snow squall. When there seemed no end to it we brought the ship into the ice, let out the fires, and cleaned the boilers. On several occasions the weather cleared to the south, giving us good conditions for a flight to the land. But around the ship the visibility was poor, and conditions uncertain. I ascribed this to the great openings of water north of the ship, and I believed that "Valdivia Bay" now had completely opened up. I therefore took the first opportunity to work the ship southwards to put more unbroken ice to the east of us, a maneuver in which we were quite successful.

On December 22 in 65° 10′ S. and 49° 30′ E. we got into the air heavily loaded with equipment, including emergency wireless gear. The skipper had orders to keep the ship due north of a couple of big icebergs of conspicuous appearance and instructions not only for the rest of this season but also until March, 1931, in case we did not return to the ship.

Weather conditions were good though not of the best. We had a southerly wind which would keep the weather clear, but to the west were great openings in the ice and hazy air. We flew some ninety nautical miles on to the coast. Under way I mapped the ice, marking on it the icebergs seen. When we had passed them I turned round and made a quick silhouette drawing of them, so that I should know them again on our return flight if we met with bad visibility.

Along the coast big tabular bergs were stranded, some far out, some close to the shore. Inside this line of bergs the ice was quite unbroken and seemed to be rather smooth, but my experience of ice in the Arctic deterred me from the risk of landing. We rounded a cape which I believed to be Biscoe's Cape Ann; we passed a little inland. With our heavily laden seaplane we could not climb the steep ascent of the

inland ice. We therefore turned to the south, in which direction we saw open water and there landed after another 25-minutes' flight.

Lützow-Holm brought the machine up against unbroken ice without hummocks whose snow-covered surface was only half a foot above the level of the sea. He opened up his engine, and the machine

FIG. 10—Cape Ann, Enderby Land, with nunataks in the distance.

climbed on to the ice. We sledged under engine power a distance towards the shore, at first thinking this would be a convenient mode of ice travel, but the surface proved less smooth than it had looked. So after heading the machine for the opening we stopped the engine. We were quite close to the inland ice where the bergs had broken off and floated away. The wall, about sixty feet high, nowhere in the vicinity offered a foothold. Close by were two snow-covered skerries; in the distance were exposed rocks, and hoping to reach them for specimens we set out on skis. We were each attended by an inquisitive little Adélie penguin. At first they followed us, but when we slackened speed after an hour's hard going they passed us and took the lead, sledging on their stomachs, propelling with their feet and flappers; and whenever we stopped they stopped too.

Shortly after we landed I saw a small cloud forming over the inland ice, a very bad sign. It meant that the wind was turning, moist air coming, with fog certain to follow. A heavy bank was already forming on the western horizon. During the march I kept my eyes on the gradually growing cloud over the inland ice. After we had gone for more than two hours I decided to return. I recollected what

Shackleton said to the Geographical Society of Oslo when he returned from his expedition to 88° S.: "We could have got to the Pole, but then there would have been no one to tell you the tale tonight." We could have reached the rocks and got our specimens, but the matter of bringing them home would have been problematical. We hastened

FIG. 11—The Norwegian flag hoisted in 66° 33′ S., 50° 40′ E.

back to the skerries (66° 33′ S., 50° 40′ E.) and there solemnly hoisted the flag presented to us by their Majesties the King and the Queen of Norway. Then we returned to the machine, warmed it up, and started for the ship.

The fog settled, not coming from any definite direction but simply growing out of the air. We got away out on the open water, the wind now due north. For some minutes we flew between the water and the clouds in a milky atmosphere, then got out into sunshine, climbing above the clouds. A bearing on Cape Ann gave us the direction of our ship. I took careful drift observations and gave Lützow-Holm a course that would bring us a little to the left of the ship's position so that we should know at which side to look for it. At our altitude the wind was with us, and we took less time than in going out. We found the two icebergs: heavy fog was just beyond them, but through an opening we fortunately sighted our ship. The machine on board, we started on our return voyage to the *Thorshammer* to replenish our coal supply. Shortly after, however, we had to stop for the fog descended all around and we could not find our way in the ice.

MEETING WITH THE "DISCOVERY"

On December 30 we met the *Thorshammer* coming eastward, but we were not able to coal until January 4. Two days later we were

ready to start again for Enderby Land. We followed the ice eastward, our route, considerably to the south of our westward track, showing (Pl. VII) how far the ice had receded in the last fortnight. On January 8 we came to the northeast corner of the great bay now worked by the current far to the west. On the south side of the ice a stiff

FIG. 12—Icebergs aground and frozen in off Queen Maud Land.

southeast gale was blowing with high sea, against which we had to seek shelter until the 11th when we crossed over the open sea to the coast ice, which we met on the 13th. Following this eastward on the next day we met the *Discovery*, and I went on board to pay my respects to Sir Douglas Mawson and the Nestor of Antarctic skippers, Captain John King Davis.

On January 15 we were stopped by the ice, which now allowed us to get close to land. To the east we saw parts of Enderby Land, to the south new mountainous land. The great ice barrier that had barred Biscoe's view southward no longer exists: 99 years has wrought this change.

I use the expression "coast ice," meaning thereby the ice that stretches out some 80 or 100 miles from the coast and does not melt away during the summer. Conditions for a ship are far safer in sea ice than in coast ice. Sea ice is not so heavily packed and drifts steadily, with leads and lakes in it. Under a heavy gale it may be pressed together locally; but I do not think there is any great risk for a properly built ship, save for icebergs. Coast ice has not the same liberty of movement. It will slacken for a southerly wind, and even a land lead may open, as we witnessed; but if a hard gale strikes the edge at any angle it is pressed tightly together and with much greater force because of the size of the floes. Furthermore, late in the season when there is no sea ice outside to dampen the swells,

FIG. 13—The *Norvegia* at the coast ice off Queen Maud Land. The ship is not easy to find from the air.

motion is set up far into the mass. With big thick cakes moving up and down and gliding backwards and forwards, a ship is in bad position.

QUEEN MAUD LAND

On January 15 we got into the air again; but, as little shelter could be found from the swells, we had to leave behind the radio and much other equipment. We flew southward, mapping a considerable stretch of new land which ran into a big bay, Ice Bay, and thence continued westward. We named it Queen Maud Land. The lead on which we landed on December 22 had disappeared. It was all ice and not very good to fly over because of its broken character. I should much prefer to have to land on Arctic ice; that is bad enough, but it offers some chance.

On our return from this flight we brought the ship to 44° E. from where we made another flight, this one very short as bad weather was indicated from the west—stiff westerly breezes giving us a drift of as much as 35° at the altitude of 3000 feet and very hazy weather in that direction. We mapped the land from where work had been suspended before westward to 43° E., where it disappeared in the haze in a westerly direction. All along were so many nunataks that it was out of the question for me to map them. I was glad enough to content myself with the coast line as given by the wall of the inland ice.

The next morning an easterly gale compelled us to seek shelter in the ice, where we immediately became fast in a bad position, with heavy ice cakes ramming our sides and a big berg bearing down on a direct course for us. The berg appeared at 7 o'clock in the evening and at 4.30 the next morning passed close to us. In the meantime we had managed to get the ship turned round, though for a long time it looked as if we should have to leave her.

GUNNERUS BANK

After the gale had subsided we proceeded westward to fulfill our program, which called for oceanographical stations along the

edge of the ice as far as Coats Land on the eastern border of Weddell Sea. Weddell Sea, it is well known, is bad even in the middle of the summer and still worse late in the season. Our ship was not built to stand winter pressure of the ice, and we had the fate of the *Endurance* in mind.

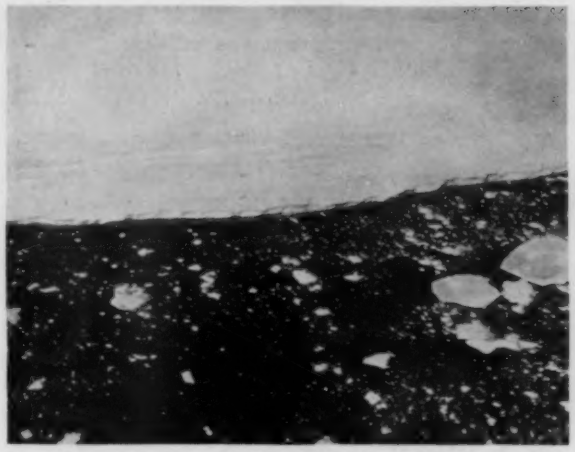


FIG. 14—Inland ice south of Enderby Land and the lead in which we landed. Cracks are seen in the ice running parallel to the wall.

On February 1 we discovered a bank in latitude 68° S., soundings giving only about 1800 feet between 32° 11′ and 32° 38′ E. We named it "Gunnerus Bank" after Johan Ernst Gunnerus, bishop of Trondhjem and naturalist, who in 1770 was the first to describe the pelagic shrimp. An appearance of land was seen sixty to eighty nautical miles south-southeast of the bank.

I shortly pass over the next three weeks of our voyage. The ice conditions encountered were quite different from those on the eastern side of the bank. The Neumayer Current seems to die away at the bank, or more probably it is deflected northwards, as we found the water to the east and the northeast of the bank crowded with small icebergs, a kind of Sargasso Sea as it were.

According to experienced whalers the weather this season was worse than usual as regards gales. It may perhaps be explained by the fact that the sea ice this year retreated south much more quickly than usual, on which account the eastern gales in the eastern part of our area were stronger than ordinarily and by sweeping the ice westwards more quickly than usual created good ice conditions between Enderby Land and Gunnerus Bank. But more ice than usual from the east had been heaped up in the western part of the area.

Apart from one place we were not able to get as far south on this part of our voyage as Bellingshausen and Biscoe did, being handicapped by the bow of our ship, which was in bad condition.

INTO WEDDELL SEA

Finally on February 16 we rounded the northwest corner of the ice and headed into Weddell Sea. A sounding in 68° 30′ S. and

11° 46′ W. gave a depth of 4935 meters, which corresponds very well with the *Scotia's* soundings of 2660 fathoms (4865 m.) in 68° 32′ S. and 12° 49′ W. and 2487 fathoms (4549 m.) in 68° 32′ S. and 10° 52′ W. In this area Ross reported 4000 fathoms no bottom but the *Scotia* found evidence here of a strong undercurrent, to whose existence is attributed the fact that the bottom is swept free of diatoms, which are very abundant in the upper layers.[7]

Routine observations at our station of that day showed that the water layer of 0° C. temperature was deeper than farther east. The temperature of the water at the surface had risen to −0.67° from −1.07°. Bird life was meager.

We continued southward with very little ice around us and took up another station in the morning of February 17 at 70° 42′ S. and 13° 0′ W. The water temperature had now sunk to −1.07°. Soundings gave us 2550 meters, the bottom seemed to be rising rapidly, and we were obviously on the right course. At about 3 p. m. we sighted a long row of icebergs trending east by north to west by south, so thickly strewn that we were certain they were aground. Our course was set towards them, and soundings were started. The bottom rose quickly: in 71° 13′ S. and 13° 11′ W. we got 314 meters. The water here was very cold, the temperature being −1.92° at the depth of 150 meters. Here trawling yielded a good haul.

We sailed among the icebergs sounding 222 meters where they were aground. In 71° 26′ S. and 12° 8′ W. we were inside the row of bergs and were here stopped by heavy pack. As it now was dark we had to wait for the coming dawn, which we hoped would bring good flying weather. We were now close to Ross's farthest south in 1843. I presume, however, that his dead reckoning was in error—a not unusual circumstance in those days, or he would have made the sensational discovery of this shallow water. He must have been farther to the west.

Crown Princess Martha Land

From the crow's nest during a short spell of better visibility I noticed in the sky to the east the peculiar light that is to be seen above inland ice. The morning of February 18 the skipper reported ice sky to the east, and this I confirmed and furthermore saw the actual inland ice itself. We headed for it. Soon it was seen rising eastwards and disappearing into low clouds. The pack offered us no difficulty whatsoever; and at noon we stopped our ship in a bay about 500 feet away from the wall of the inland ice, where we sounded 160 meters.

[7] See the reports on the Scottish National Antarctic Expedition in *Scottish Geogr. Mag.*, Vol. 21, 1905, especially pp. 28, 37, 405, 414.

We had to work quickly, for the season was far advanced. In spite of the threatening weather conditions we got into the air with our seaplane and followed the land southward and then to the southwest. Clouds and fog compelled us to fly lower and lower until it was all fog about us and we had to return. Conditions were a little better at the ship; we could here rise to about 350 meters, which also was the altitude of the inland ice. We proceeded east of the *Norvegia's* position, following the coast line. Farther east the ice was level, at places indicating floating barrier ice. As the visibility to the south did not allow us to see far enough to determine where the rise commenced, we could only sketch the edge of the barrier. The wind, which had been southwest when we started, now changed to north of west. We therefore returned and passed through a snow squall just before reaching the *Norvegia*, where we landed after a flight of two hours. Half an hour later all was fog.

We went several miles into the bay and got a sounding of 608 meters, indicating somewhat deeper water on the landward side of the bank. Here we stopped for the night but had to be on our guard as we might easily be trapped by the ice. The next morning (Feb. 19) the bay was nearly filled up with pack.

Because of the abundance of seals we named the place Seal Bay. Inside was smooth, broken bay ice with no sign of hummocks in the inner part. I think it might afford winter quarters for a ship, but it has one rather serious drawback. It is a question as to whether the ice will open up from one season to the next. Personally I would not take up quarters here unless I had provisions for at least two years.

We passed outside the row of bergs and proceeded westward to 71° 26′ S. and 14° 58′ W., where we were stopped by the pack, which here took a northerly direction. We had now come to the western limit of our area.

A southeast wind brought clear weather on February 20, and Lützow-Holm and I got into the air again. A layer of clouds at 1000 feet gave us some difficulty. Below the clouds we could not see far, for the undersides hung like draperies. We passed through the cloud zone climbing to 5000 feet and on to the southeast. The clouds disappearing southward, we now saw the coast line from Coats Land to the south and southeast of us and a little later also to the east, giving us connection between Coats Land and the land discovered two days before.

No nunataks were observed protruding through the ice, neither here nor farther east, this land which we named Crown Princess Martha Land having the same character as the neighboring lands—Coats Land, Caird Coast, and Luitpold Land.

Very, very far to the south we observed something which might be a mountain range or a cloud. We could not investigate further,

for a gale from the southeast was approaching and hastened our return to the ship. The expected gale did not keep us waiting long; it started blowing in the afternoon and increased rapidly in strength. Under the shelter of the stranded icebergs we succeeded in advancing against it and got back the same night to Seal Bay, where we stopped close to land in comparatively smooth water, the wind being offshore.

FIG. 15—Barrier tongue at Crown Princess Martha Land with icebergs floating off.

We had had many gales this season, for it blew when the barometer fell and blew when the barometer rose, and the barographic record looked like a scenic railway. But they were nothing compared to what we had to go through from that Friday till Sunday (February 21–23). The velocity of the wind on Friday averaged 27 meters per second, with more than 30 meters per second during the squalls. The wind, coming offshore, brought squall after squall of snow, and only occasional glimpses could be had of the land. We were compelled to run full speed ahead to keep our station.

The air temperature was −7° to −10° C., ice settling all over the ship from the spray. It was fortunate that we could keep so close to land, for the waves had not room to rise high enough to break over the ship. An overload of ice would have been very bad under those conditions.

At 6 o'clock Saturday morning the blowing suddenly stopped, and we had a dead calm for some minutes. Then with short intervals hard squalls came from all directions between southwest and southeast. A strong squall from the southwest compelled us to steer the ship out from land; then came another from the east of an unbelievable strength. The velocity was about 50 meters per second. Well, we got through it, but the situation was rather bad: we feared that the pack might any moment close up outside the bergs. As soon as the squalls were over and it was blowing steadily again, we went out to

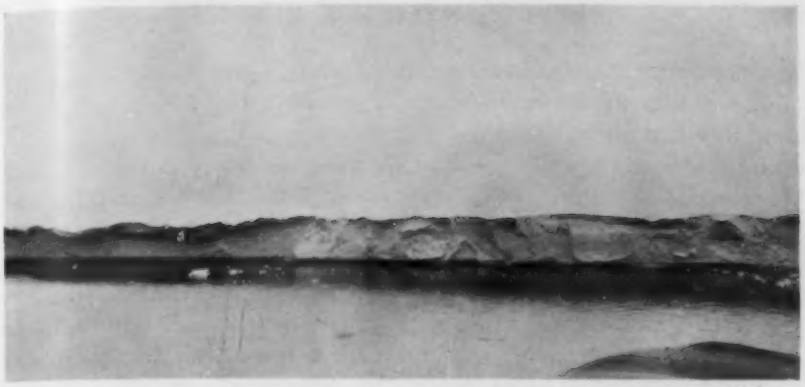


FIG. 16

FIG. 17

FIG. 18

FIG. 16—The twenty-meter-high wall of the inland ice, Crown Princess Martha Land.
FIG. 17—Floating barrier off Crown Princess Martha Land.
FIG. 18—The *Norvegia* off Crown Princess Martha Land.

The American Geographical Society of New York NORVEGIA ANTARCTIC EXPEDITION
MAPS SHOWING THE NEW LANDS DISCOVERED BY THE EXPEDITION

the northwest cape to investigate. To our joy we here found such a high swell that there could be no ice outside as yet. We had another long day and night, rather exciting because at times we were not able to keep the ship against the sea. Reading about the hurricanes which Mawson experienced at Adélie Land had given me a shiver. Now we too were experiencing them and on board a small ship, which made them the more alarming.

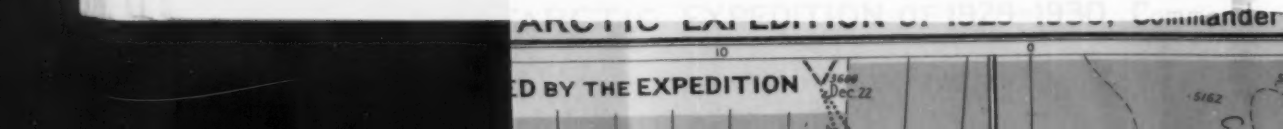
Shackleton said, "No good things last long." That is quite true down in the Antarctic; but bad things also come to an end, and finally on Sunday morning the weather improved so rapidly that shortly we were able to say farewell to Seal Bay.

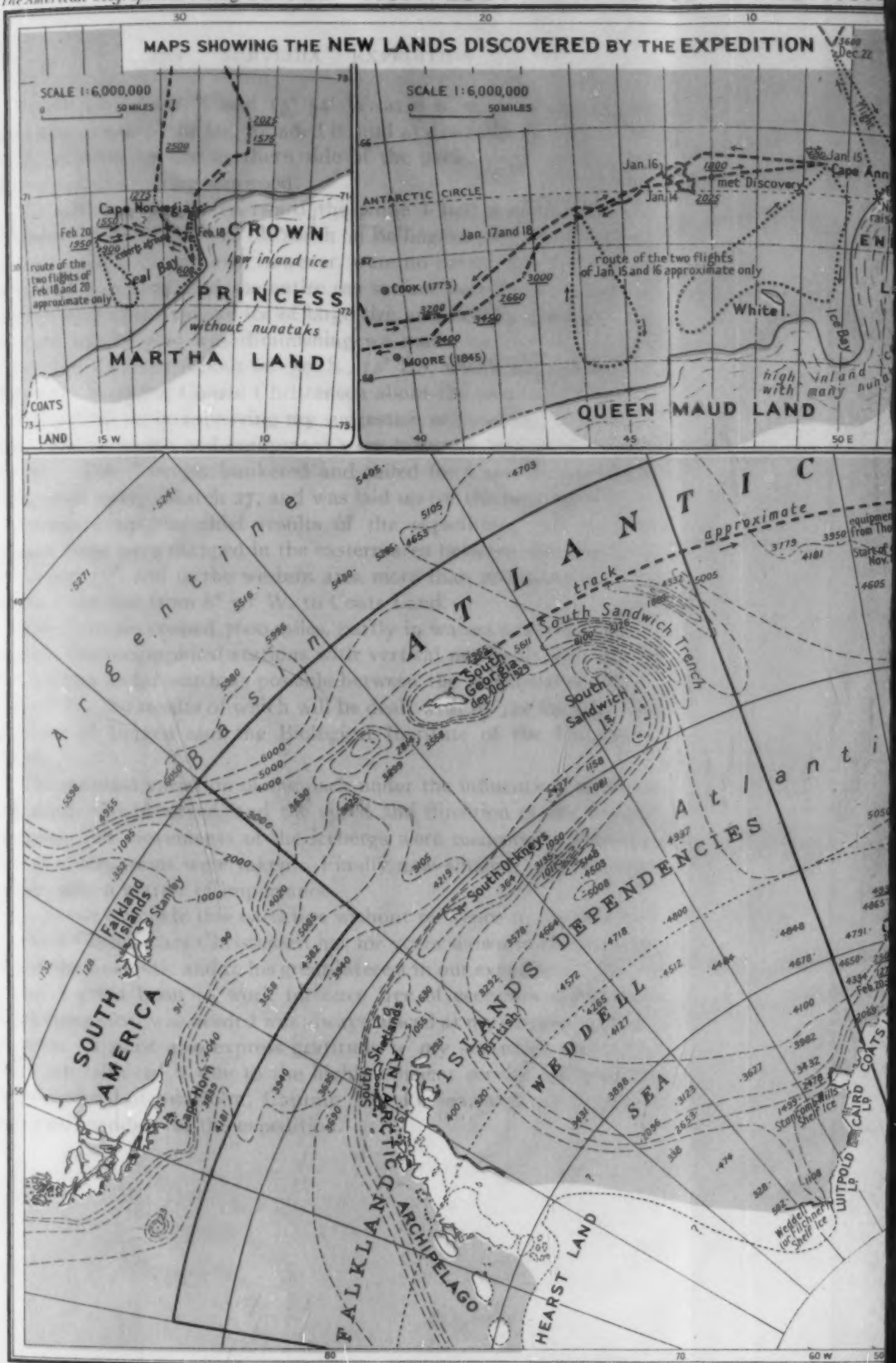
We steamed along the coast to the eastward, mapping it from the ship, until we met the pack, which took a more northerly direction the farther east we went. As I feared, the pack north of us had drifted a considerable distance to the west during the gale, compelling us to work back westward again in order to get out. It was now February 23, a rather late date to be in Weddell Sea. The temperature of the water was at freezing point, and the air temperature also was getting low. Any moment we might expect pancake ice to start forming when the wind slackened. During the strong blow the salinity of the surface water most likely had risen on account of the evaporation. As soon as the wind slackened this condition would change. As the little more that could be achieved stood in no reasonable relation to the grave risks we were running by staying here longer, I decided to finish our work as quickly as possible. We therefore headed northward.

During the night the wind died down, and pancake ice began to form. The fresh southwesterly breeze of the following morning was unable to break it up. It was quite strange to be in the crow's nest listening to the wind blowing in the rigging and seeing the sea surface quite smooth apart from the swell, the pancakes still having the same color as the water.

The Return

Stopped by the ice to the north we soon had to retreat westward. We crossed the meridian on which we had passed unencumbered by ice into Weddell Sea. Figuring that the ice had been checked by the southwesterly wind the first days after we got in, and giving it a speed of 25 miles a day during the gale, I estimated that we should find its western limit at about the meridian of 14° W. I was unwilling to enter the ice before I was compelled to. Not only was our bow in a serious condition, but with all the open water to the north and east of the pack bad visibility would be certain. And to work the ship into the ice without seeing anything would mean that we might easily be held fast for the winter.





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ED BY THE EXPEDITION
Dec. 22
Jan. 16
Jan. 15
Cape Ann
met Discovery
Jan. 14
Norwegian flag raised Dec. 27, 1929
ENDERBY LAND
route of the two flights of Jan. 15 and 16 approximate only
White I.
Ice Bay
high inland ice with many nunataks
QUEEN MAUD LAND
45
50 E
approximate
equipment transferred from Thorshammer
Start of expedition Nov. 6 1929
Bouvet I.
Sandwich Trench
track approximate
ANTARCTIC CIRCLE
March I.
BELLINGSHAUSEN (1820)
Biscoe (1831)
Quoist (1927)
CROWN PRINCESS MARTHA LAND
COATS LD
CAIRD
LUITPOLD
Stefansen Bills Shelf Ice
Lindo
Wegdell Fichner Shelf Ice
SEA
Atlantic
Indian
OCEAN
PENDENCIES
MAP SHOWING
THE FIELD OF OPERATION
OF THE EXPEDITION
SCALE 1:25,000,000
0 100 200 300 400 500 MILES
0 100 200 300 400 500 KILOMETERS
New land discovered by the expedition
Track of the "Norvegia" (----- airplane fl
4815 Echo soundings (in meters) made by the
Isobaths (submarine contours) interval
70 60 W 50 40 30 20 10 0 10 20 30 40 50 60

A. Hoen & Co. Baltimore

UNIV. OF MICH.

Finally at 69° 28′ S. and 13° 54′ W. at 8 p. m. we came to the southwest corner of the ice, rounded it, and at dawn the next morning found ourselves on the northern side of the pack; and, the weather being good, everything was good.

We followed the ice eastward the while I had a small hope up my sleeve for an advance to the south on Bellingshausen's and Biscoe's farthest south. Conditions, however, were no better now than when we passed westward, and the entire sea surface outside the pack was covered with new pancake ice of large size and rapidly growing. As our coal supply also was diminishing we made for the rendezvous of the *Thorshammer* (about 66° 50′ S., 12° E.), which we reached on March 2. Radioing Consul Christensen about the situation, I immediately got his reply approving my suggestion of finishing the expedition. The airplanes and equipment were taken on board the *Thorshammer*. The *Norvegia* bunkered and sailed for Cape Town, where she arrived safely, March 27, and was laid up for the next season.

Summing up the chief results of the expedition, 370 nautical miles of coast were mapped in the eastern area between the meridians of 43° and 55°, and in the western area more than 200 nautical miles of new coast line from 8° 30′ W. to Coats Land.

The *Norvegia* cruised 7600 miles, partly in waters never navigated before. Oceanographical stations with vertical net hauls were taken on a section as far south as possible between the meridians of 53° E. and 15° W., the results of which will be dealt with by the Geophysical Institute of Bergen and the Biological Institute of the University of Oslo.

The seasonal variation of the pack under the influence of currents and winds was observed, and the speed and direction of the drift of the pack and movements of the icebergs were measured. Meteorological observations were taken. Finally new whaling grounds were found—also a matter of importance.

I cannot conclude this narrative without reference to the unselfish devotion Consul Lars Christensen has for years shown in the exploration of the Antarctic and to his great interest in our expedition. To me it was a great boon to work for once free of economic difficulties. What equipment was needed was always placed at my disposal without question. I must also express gratitude to my seventeen comrades. What we achieved is due to the highly efficient service rendered by Commander Lützow-Holm, Captain Nils Larsen, and every one of the other members of the expedition.

THE AGRARIAN PROBLEM IN CHILE

George McCutchen McBride

University of California at Los Angeles

CHILE is essentially an agricultural country. The world knows her best for her mineral resources, nitrate and copper in particular; but it is not in exploiting these that most of her population is employed. Relatively few of the Chilean people have ever seen those sources of national income, the *salitreras* of the northern desert and the mines hidden deep in the Andean canyons, nor have they seen the great forests that constitute the potential wealth of the south. Chile's population lives on the soil. Many even of her urban dwellers—forty-six per cent of the total inhabitants—retain close relations with the farm, as owner, renter, tenant, or hired laborer. Sprung from an ancestry that tilled the fields of Spain, they have found similar climatic conditions in these fruitful vales between the Andes and the sea; and during the four centuries that they have been in America they have carried on a Mediterranean agriculture, making that industry the basis of their entire social order.

Limited Agricultural Land

Even the casual visitor recognizes that he has not known the real Chile until he has seen the lovely rural landscapes of the Central Valley. Rich fields of alfalfa reflecting the sun in their abundant irrigation water; fat cattle wading deep in green pastures; level wheat and barley fields fringed with low rows of Lombardy poplar, weeping willow, or eucalyptus trees; and occasional glimpses of orchard and vineyard or palatial country homes and grounds—these, all laid close to the foot of the snow-crowned Andes, form the picture the traveler carries away of Chile as she is. Her life is agricultural to the core. Her government has always been that of farm owners. She has never had a president, I think, who did not have a farm and spend a part of his time on it. Her congress is made up chiefly of rich landlords. Social life is dominated by families whose proudest possession is an ancestral estate. All the élite have rural properties. The typical Chilean of the poorer classes is a *huaso*, a country fellow accustomed to the hard life of the field. Chile's agricultural products have not figured conspicuously in her exports; but neither has she had to buy from abroad. Her farms have fed her people and made her economically independent for most of the necessities of life.

Yet Chile's agricultural area is decidedly limited. In 1925 her four northernmost provinces, with a total area of 266,935 square kilometers, contained only the following productive farm lands:

Cropped lands .	43.42	square kilometers
Artificial pasture	156.21	" "
Arboriculture .	67.23	" "
Total . . .	266.86	" "

Of this third of the republic just one-tenth of one per cent was used for agricultural purposes. The rest was desert. In the three provinces of the far south (Magallanes, Chiloé, and Llanquihue),[1] with a total area of 276,956 square kilometers, there were only the following lands being used agriculturally:

Cropped lands .	1,202	square kilometers
Artificial pasture	1,998	" "
Arboriculture .	24	" "
Total . . .	3,224	" "

Thus this second third of the national territory has so far brought into agricultural use but one per cent of its area. This will be increased; but most of the great forests that are gradually yielding to the ax and fire occupy land, particularly south of Chiloé, that is too rough or too bleak in climate to be fit for successful farming. With these two-thirds of her territory of almost negligible value agriculturally, even the remaining third has much useless land.

The central section of the country consists of three major subdivisions approximately equal in extent. There is the Coast Range; the Central Valley (with several smaller adjoining valleys); and, to the east of these, the massive Andean Cordillera. The last may at once be eliminated from the picture of agricultural Chile, and to a great extent the Coast Range also, though a few of the gentler slopes in

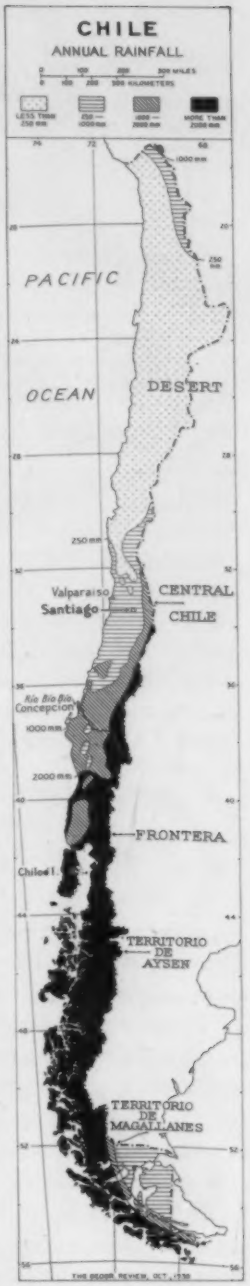

FIG. 1—Limitations of Chilean agriculture. Map based on W. Knoche's map, 1:5,000,000, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1929, No. 5–6.

[1] The reorganized provinces (decree of 1927) are Territorio de Magallanes, Territorio de Aysen, and Chiloé. See W. E. Rudolph: The New Territorial Divisions of Chile with Special Reference to Chiloé, *Geogr. Rev.*, Vol. 19, 1929, pp. 61–77.

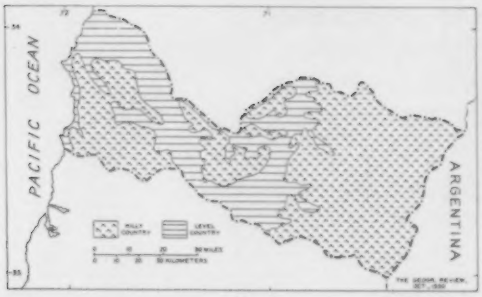

FIG. 2—Sketch map of the Province of Colchagua (before the territorial changes introduced by the decree of 1927) showing proportion of hilly and level country. Only about one-ninth of its area is under cultivation.

this latter region are cultivated. Figures for some of the central provinces that extend from the sea to the Andean crest show how serious is this lack of land. Take, for example, the well developed Province of Santiago. Out of an area of 15,260 square kilometers, the land under cultivation in 1925 was as follows:

Cropped lands	590	square	kilometers
Artificial pasture	502	"	"
Arboriculture	83	"	"
Total	1,175	"	"

This total is a little less than eight per cent of its surface. The Province of Colchagua, offering perhaps the most complete utilization of available agricultural land in the country, shows similar conditions. But of an area of 9973 square kilometers, only the following were devoted to farming in 1925:

Cropped lands	749.8	square	kilometers
Artificial pasture	304.9	"	"
Arboriculture	55.3	"	"
Total	1,110.0	"	"

This is just over eleven per cent of its area. The Province of Talca shows eight per cent, and Aconcagua only four.[2]

These examples are typical of the Central Valley. All of these districts have been occupied by whites for nearly four hundred years, and they represent the most thickly populated parts of the country. As will be noted farther on, some allowance must be made for the agrarian system, which has not brought all lands into the most intensive use; but there is little tillable area in the central provinces that is not included in the figures that have been given. There are of course large hilly areas bearing native grass that are used for pasture; but most of such grasslands are so dry or so mountainous, or both, there is little prospect that they will ever be cultivated and hence little reason to consider them as distinctly agricultural.

[2] *Annuario Estadist. de la República de Chile*, Vol. 7, Agricultura, Año 1925–1926. These figures, of course, refer to the territorial division existing before 1928.

The Social Situation

In such circumstances one would expect to find that the problem of landownership had long been acute in Chile. Such is not the case. Until recent years the country has been little disturbed in this respect. Her population has not been large nor has it increased rapidly. The

Fig. 3—Cleared land and the edge of the forest a few miles from Ancud, Island of Chiloé.

development of irrigation has gradually added new and very productive areas, while the timbered regions of the south, though offering discouraging difficulties to a people unaccustomed to forests, have provided a vent for the slowly increasing population. In addition, the rural laboring class, the group that most severely felt the evil effects of the existing system, has been virtually without means of making its needs known. The few efforts that have been made have never been backed by strong popular demand.

This situation has been gradually changing in the last twenty-five or thirty years. The point of saturation of population density has been approached in several of the central provinces—in Valparaiso with seventy-three persons per square kilometer, Santiago with forty-nine, and Concepción with thirty, in each case with only a small part of their lands suitable for agriculture. Industries have sprung up in a number of the larger centers with a group of class-conscious laborers who have begun to share the discontent of industrial workers elsewhere and have spread their spirit of unrest into the adjoining rural districts.

The years immediately following the World War were anxious times for the Chilean capitalist in both city and country. It was plainly seen that the nation faced a condition as fraught with peril

to the existing order as did Mexico, Russia, or Italy. Since 1924 the situation has improved, and it is possible that a crisis has been averted. The government has not limited itself to mere repression. That has been vigorous, but with it has gone an attempt to cure the ills of which the social unrest was but a symptom. A vast program of public

FIG. 4—Building a home under difficulties; a newly married couple's partly cleared farm in the Scotch colony, Huillince, on the Island of Chiloé.

works has virtually done away with unemployment. Social legislation more advanced than in any other American republic has been enacted. The laboring class has frankly been invited, for the first time, to play its part in the governing of the Republic; and the organization of a labor party with strong constituent syndicates has been fostered. Coupled with this goes a far-reaching program destined, if completely carried out, to abolish the underlying evils of Chile's traditional land tenure system.

THE AGRARIAN PROGRAM

The main features of this really heroic agrarian program are as follows: colonization of the remaining public lands; extension of irrigation; provision of rural credits, particularly to small proprietors; development of agricultural coöperatives; clearing of titles to property in the already settled sections of austral Chile, coupled with the abolition of still existing Indian communities there; subdivision of large rural properties in the central section of the country and foundation of agricultural colonies on their lands.

In carrying out the program of irrigation development there was added between 1924 and 1927 over sixteen per cent to the irrigated

area of the country. Projected works should bring under cultivation within the next five years some 200,000 additional hectares. These new lands lie both in the northern desert section and in the central region, where intensive farming is impossible without irrigation. Homesteads for 12,000 families will be provided and will thus afford

FIG. 5—Colonist's home in the forest near Temuco, Province of Cautín.

a small outlet for the increasing population and materially enlarge the food production of the country.[3]

The securing of rural credits is not only making for more successful farming on the small properties already in existence but is also fostering the creation of small farms in all parts of the country. The few agricultural coöperatives already formed are giving the small proprietor the advantages of large-scale expert marketing, thus enabling him to compete with the *hacendado*, and will make it possible for him to weather a series of bad years such as occasionally come to central Chile with her scant and variable rainfall. Heretofore these years have been tragic for the farmer without means of securing credit. In the excessively dry year of 1925 hundreds of these farmers became bankrupt.

In the plan of colonization a determined effort is being made to people the south—Chile's frontier and her only avenue of expansion. To this end the government is seeking to ascertain the extent and character of still existing fiscal lands in that region, particularly in Magallanes Territory and in the newly created Territory of Aysen, large sections of which are unknown. These are being explored and mapped and opened up for settlement by either Chileans or foreigners.

[3] *Memoria del Ministerio de Fomento*, 1928.

FIG. 6—Farms reclaimed from the forest along the Maullin River in the Province of Llanquihue (old territorial division).

Here a new type of property is being formed, the *hijuela ganadera*, or cattleman's homestead, 500 hectares (1235 acres) being the extent considered necessary for such holdings. Much of this region has been leased in former years to large companies, who in turn have sublet parcels to colonists. The policy of making these extensive leases has been abandoned, the areas reverting to the state at the expiration of such contracts now being rented or sold in smaller blocks directly to the settlers. During 1928 in Magallanes Territory 100,000 hectares were received back from a single company, and many parcels of this were rented to individuals until final arrangements could be made for the granting of deeds.[4] Colonization is being planned also for the unoccupied sections of the Island of Chiloé, where during more than three hundred years of struggle against the forest the line of clearings has been pushed back but a few kilometers from the coast. The dense growth of timber and the mat of *quila* (bamboo) that fills all space between the trees make this entire southern region, and particularly Chiloé, one most difficult to settle.

"Propiedad Austral"

The feature of the government's agrarian program of greatest current interest to Chileans is that which deals with what is known as the *propiedad austral*. The district on the mainland extending southward from the Bio-Bio River through somewhat more than three degrees of latitude was, until the middle of the nineteenth century, an almost unbroken expanse of forested country valiantly held through three hundred years by the unconquered Araucanian Indians. Into this territory neither the armies of Spain nor those of the Republic had been able to extend the line of settlement save at a few points where nearness to the coast or to navigable rivers had given the invaders a foothold. With the final breaking down of aboriginal resistance, beginning about 1850, the region known as the *Frontera* was slowly but firmly occupied by colonists, in the first years chiefly Germans under contract with the Government.[5]

Since 1900 the southward movement of native Chilean settlement has been going on with increasing momentum. In 1903, when the railway line was built through this territory from north to south, the writer traveled on the first through train and found the country an almost uninterrupted forest in which few inhabitants other than Indians were seen. Recent tours made through the same country have shown large parts of it cleared, fenced, and cultivated; and in one railway journey through the whole of the old Araucanian territory not a single Indian, at least in native dress, was seen. One is reminded

[4] *Ibid.*

[5] Cf. Mark Jefferson: Recent Colonization in Chile, *Amer. Geogr. Soc. Research Ser. No. 6*, New York, 1921.

of the rapid transformation of eastern Oklahoma that followed the opening of that district to white settlement.

In the problems presented to the government, however, this southward movement more resembles the expansion of the American colonies into the trans-Allegheny territory; for settlement here, as was the case there, has far outrun government provision for it. The Chilean settlement has been a spontaneous migration of individuals,

FIG. 7—A typical colonized section of the south, Malleco Province. Drawn from Carta General de Colonización, 1917; scale 1 : 100,000. This land is not irrigated, depending upon the 40 to 60 inches of rain, most but not all of which falls in the winter. Wheat is the main crop. The majority of the lots are 20, 40, or 60 hectares in area. There has been a steady process of combining several (in some cases many) of these *hijuelas*, homesteads, into one farm. Compare this with Figure 8, showing an area of the same size.

rather than a directed colonization. The foreign groups received their lands in orderly fashion and, so long as they confined themselves to the lots assigned them, enjoyed full security of titles. But the Chilean settlers in many cases did not wait for the homesteads to be provided by the government but sought out lands that suited them and forthwith took possession. Many among both groups received a homestead and then proceeded to enlarge it by occupying adjoining areas. The presence of the Indians, their loose claims to ill-defined lands, their willingness to dispose of whatever claims they had, and their inability to protect themselves from the wiles of the invaders further complicated the problem, until at the present time there are some 47,000 properties whose titles are in doubt.

So vitally is the security of rural holdings in the south affected and so profoundly does it influence the prosperity of the region that the unusual measure has been adopted of creating a special cabinet department to deal with the situation. This new ministry, entitled that of the *Propiedad Austral*, has been committed to one of the most devoted and trusted of Chile's public servants, and it is expected that at least three years will be required to bring order out of the existing chaos. All legally acquired titles are being filed (many of them for the first time), and "squatter sovereignty" is being recognized in that actual occupation for a period of ten years and due improvement of the property are being accepted in lieu of formal deeds.

Closely coupled with the problem of the *propiedad austral* is that of the subdivision of Indian communities in the old Araucanian territory. When the armed opposition of the Indians on this frontier was finally overcome each chief was given a collective title (*título de merced*) to the area which he and his people had held in a somewhat similar collective fashion up to that time. These lands were indivisible and inalienable and were to be held simply in usufruct. Pressure of

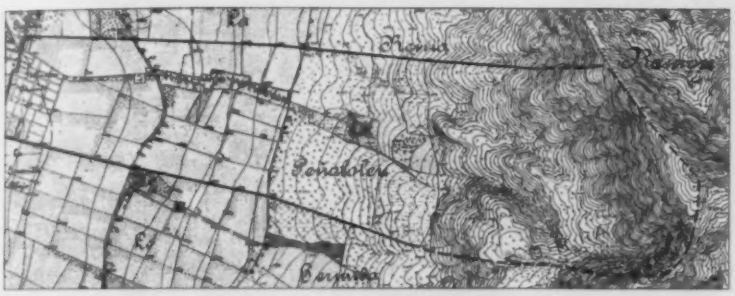

FIG. 8—Plan of a typical *hacienda*, Peñalolén, in the Central Valley. It contains 1800 acres of irrigated land, getting water from the two canals shown, both of which are taken from the Maipu River. More than half of the farm is waste land, much of the highest part being bare rock. The owner's large house and grounds may be seen on the piedmont slope, the road leading down through the farm being lined with the 40 *inquilino's* houses each with an acre or two attached. The irrigated part is divided into fields by fences and rows of trees. A plot in the lower end has been subdivided into town lots and forms part of the city of Nuñoa, a suburb of Santiago. Compare this with Figure 7, showing an area of the same size. Reduced to scale of 1:100,000 from the Carta Topográfica de Chile, Peñalolén sheet, scale 1:25,000.

white settlement has now led the government to undertake the subdivision of these holdings and their allotment in severalty to the members of the respective communities. Some steps in this direction had already been taken; but in 1928 there were 3278 such reserves, *reducciones* they are called, affecting 80,661 persons and consisting of 503,343 hectares valued at 150,000,000 pesos.[6] The new law providing for this individualization of Indian community land was passed in January of this year and was put into effect by regulations on March 1. Since it provides that Indians may, under certain restrictions, alienate their lands, it virtually means extinction of the long maintained Araucanian independence.

THE DOMINANCE OF THE HACIENDA

The problem of the subdivision of large agricultural holdings in the central part of the country is the most difficult but probably the most important phase of the government's agrarian program. Chile, in common with the other Spanish-American republics, inherited the system of *latifundia* from Spain and like most of her sister republics

[6] Publication cited in footnote 3.

failed to find a way of modifying this form of land tenure. In fact, in few of these countries has the system remained so firmly established. In 1925 there were 570 farms in the country of more than 5000 hectares each. Most of these were in the central region, the old settled section. The province of Santiago, for example, had fifty-one such properties which occupied altogether three-fourths of the total area

FIG. 9—Owner's house and garden on a Chilean *hacienda*.

included in rural holdings. Out of a total of 3131 farms it had 403 of more than 200 hectares each, including in the aggregate 1,225,506 hectares; while the remaining 2728 properties combined contained but 48,769 hectares. In the entire country, 2576 large owners held 20,321,623 hectares out of a total of 25,679,107 hectares included in all rural properties.[7] It is true that much of the land in these large farms is of little present agricultural use, but the same may be said of the smaller properties. Both types contain their share of good and bad land. The monopolization of land in these central provinces may be seen by noting the diminutive size of most of the small farms. In Aconcagua, for example, the 3895 smallest rural properties contained a total of but 3715 hectares; and in Valparaiso 1517 of them aggregated but 2024 hectares.

There have been in Chile, perhaps, fewer of the evils attendant upon such a system than in many other places. The *hacienda* has dominated the social, economic, and political life of the nation; it has divided the population into distinctly separated classes, patron and peon; it has delayed the development of intensive agriculture; it has prevented the participation of the vast majority of the Chilean

[7] Publication cited in footnote 2.

people in their government; it has left fully half of the population without property and the stimulus that is born of proprietorship. But it has not brought abject poverty to its tenant class, as was the case in Mexico; nor has it bred abject servility in its laborers, as it has in Peru. The rule of the *hacendado* has been in general a benevolent one, with many patriarchal features that have softened its asperity

FIG. 10—Harvesting alfalfa on a Chilean *hacienda*, in the Central Valley.

and created a strong bond of union between rural employer and employee. It has been the means of developing in Chile the beautiful country estates in which wealth, leisure, culture, education, and taste have combined to give the rural landscape a charm found in few other countries of the world. But Chilean statesmen have seen that the country cannot hope to reach the desired intensiveness of economic development nor constitute a real political democracy nor meet the future which modern social tendencies are bringing about until it has modified its ancient system of land tenure out of which its social institutions have grown. To this end they propose to reduce the size of the very large holdings and create numerous smaller ones.

BREAKING UP THE LARGE ESTATES

The breaking up of large farms has been going on for some years by natural processes stimulated by methods of taxation and legislation against entailed estates. Recent years have seen the movement somewhat accelerated by voluntary subdivision, particularly in the vicinity of large cities; but such progress proved too slow. Those familiar with conditions in Chile feared that a violent overturn might be precipitated, and in the years 1920 and 1921 the looked-for upheaval

seemed imminent. Since that time, however, and particularly during the last few years the problem has been attacked in a way that commands admiration both for its energy and its moderation.

Under the terms of a law promulgated December 10, 1928, a "Caja de Colonización Agrícola" was created and provided with a fund of 100,000,000 pesos to be used in the founding of agricultural colonies composed of either Chileans or foreigners. Land for these colonies is to be acquired in such manner that the President of the Republic is empowered to expropriate the necessary areas on the grounds of public utility. Lands may be acquired in this latter fashion only within fifteen kilometers of railways, stations, and ports, or within five kilometers of principal roads, navigable rivers, and lakes. Furthermore, all properties north of the Bio-Bio River, the region of irrigation farming, of not more than 300 hectares and all south of that river of not more than 500 hectares and properties already intensively cultivated anywhere in the country are exempt from such expropriation.

The first colony under the Caja was formed with forty-three German families selected by the Chilean consul in Hamburg with the hope that they would thrive as their compatriots of southern Chile have done. A farm containing 344 hectares of level irrigated land suitable for the raising of wheat, barley, maize, potatoes, and other truck crops as well as alfalfa, fruits, and nuts, was purchased in open market for this purpose. Each family has received ten hectares of land and a comfortable house ready for occupation, with roads, fences, and irrigation canals constructed. Easy terms of payment are offered. The colony is so near the capital that there should be little difficulty in finding a market for their produce.

Two other such properties have been acquired, and colonies are being formed on them. The Caja is authorized also to obtain land in the same way to accommodate any group of not less than ten experienced agriculturists who may wish to secure small parcels of land to be cultivated by themselves. In all these colonies the individual holdings are small, varying from ten to forty hectares of irrigated land and not exceeding 500 hectares where irrigation is not employed. Though up to the present time no expropriations have been necessary—and it is likely from the number of properties on the market that none will be for some time—it is clearly understood that the government reserves the power to make such confiscations.

If the agrarian program can be carried to completion as sanely as it has been begun, it should be possible to avoid the period of turmoil that often accompanies such a transition, should leave the prosperity of the landowners much less affected than was the case in Mexico, and should result in more rapid progress economically and a far greater degree of general welfare for the Chilean people.

AIR TRANSPORTATION IN LATIN AMERICA

H. Case Willcox

TEN years have passed since the opening of the first aerial transportation route in Latin America. Eleven independent companies maintaining 40,744 miles of airways, regular service, and operating on a scale of about 10,000,000 miles of flight a year are the results.

The pioneer period with its problems of establishing the value and practicability of air transportation, of creating air-mindedness, and of attracting financial support is ended. Further development lies now in the hands of the capitalist, the efficiency engineer, and the transportation expert. Plans are rapidly developing for the combining of air lines with existing land and water transportation routes. It is planned, for instance, to reduce the trip from New York to Buenos Aires, now possible in ten days, to five days by means of lighted airways and night flying, the straightening out of routes by operating over long water jumps with radio-equipped, high speed, multiengined seaplanes, and by efficiency of management and operation. Comfort and convenience are to be combined with speed in the facilities offered to travelers between the two continents. Through dual passage tickets acceptable on parallel air and water services with the privilege of alternate use of transport are planned.

Fully to appreciate this remarkable progress one must realize that it has taken place in a region still largely in the pioneer state of development. The only areas served by an adequate network of railways are the Argentine pampa, Uruguay, and southern Brazil. Some progress has been made in the construction of motor roads; but in this, as in the case of the railways, the cost of construction even over the most needed routes is, for the most part, out of all proportion to the amount and value of products to be transported and the number of travelers demanding transportation.

Until the advent of the airplane the greater part of Latin America depended on the pack train, the river boat, the coastwise steamer, and a few short railway lines. Such means of transportation, though arduous and slow, have served sufficiently well up to fairly recent times; but, with the attempt on the part of the Latin Americans themselves and more particularly on the part of foreign investors, to develop the resources of Latin America by modern methods, there has arisen a demand for more rapid means of transportation at least for passengers and the mails. Motor roads will be built, railways will

UNITED STATES
MEXICO
CUBA
BAHAMA ISLANDS
HAITI
SANTO DOMINGO
GUATEMALA
HONDURAS
NICARAGUA
COSTA RICA
PANAMA
VENEZUELA
COLOMBIA
ECUADOR
PERU
BRAZIL
GUIANAS
BR.
DU.
FR.
Leeward Islands
Windward Islands
ATLANTIC
OCEAN
PACIFIC
OCEAN
El Paso
Ciudad Juarez
Nogales
Cananea
Nacozari
Chihuahua
Parral
Monterrey
Torreon
Durango
Mazatlan
Zacatecas
Aguascalientes
León
Mexico
Vera Cruz
Tampico
Tuxpan
Brownsville
Matamoros
Merida
Campeche
Villa Hermosa
Carmen
Minatitlan
Cozumel I.
Belize
Tela
S. Geronimo
Guatemala
S. Salvador
Tegucigalpa
Pto Cabezas
Managua
Puntarenas
San José
David
Panama
Cristobal
Miami
Nassau
Havana
Camaguay
Bayamo
Santiago
Port au Prince
Santo Domingo
San Juan
St Thomas (Virgin Is)
St Johns (Antigua I.)
Pto Castries (St Lucia)
Curação
Santa Marta
Barranquilla
Cartagena
Lorica
Calamar
Malangue
Maracaibo
Maracay
La Guayra
Caracas
Port of Spain (Trinidad)
Ciudad Bolivar
Georgetown
Paramaribo
Montenegro
Pará
São Luiz
Natal
Pernambuco
Maceio
El Banco
Sautata
Pto Wilches
Bucaramanga
Barranca Bermeja
Pto Berrio
Quibdo
La Dorado
Bogotá
Girardot
Istmina
Ibague
Buenaventura
Tumaco
Esmeraldas
Caraques
Manta
Sta Elena
Guayaquil
Pto Pizarro
Talara
Paita
Chiclayo
Pimentel
Pacasmayo
Trujillo
Chimbote
Yurimaguas
Moyobamba
Contamana
Masisea
Pto Bermudez
Iquitos
Orellana
Villa Bella
San Ramon
Riberalta
Guayara Mirim
Bahia
108
96
84
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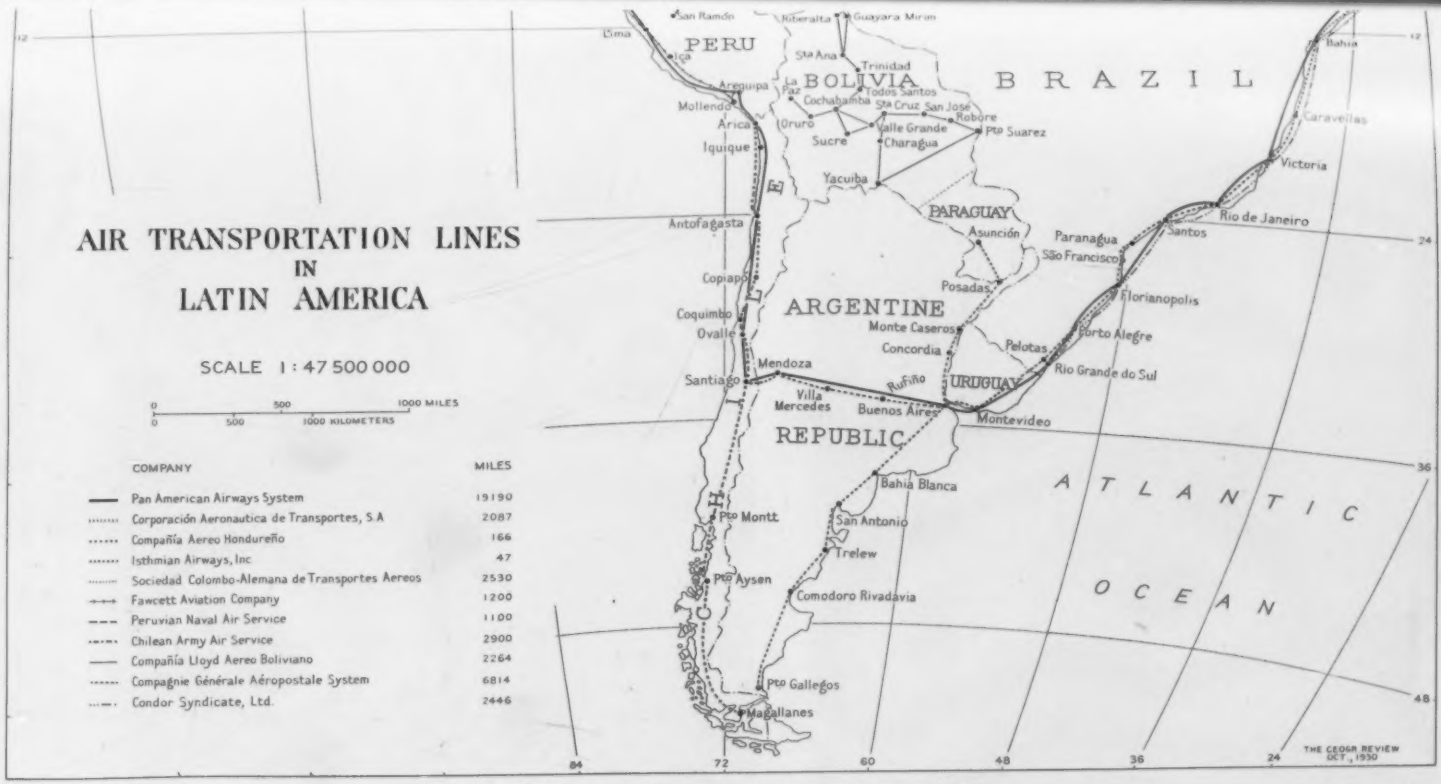

FIG. 1—Air transportation lines in Latin America in August, 1929.

FIG. 2

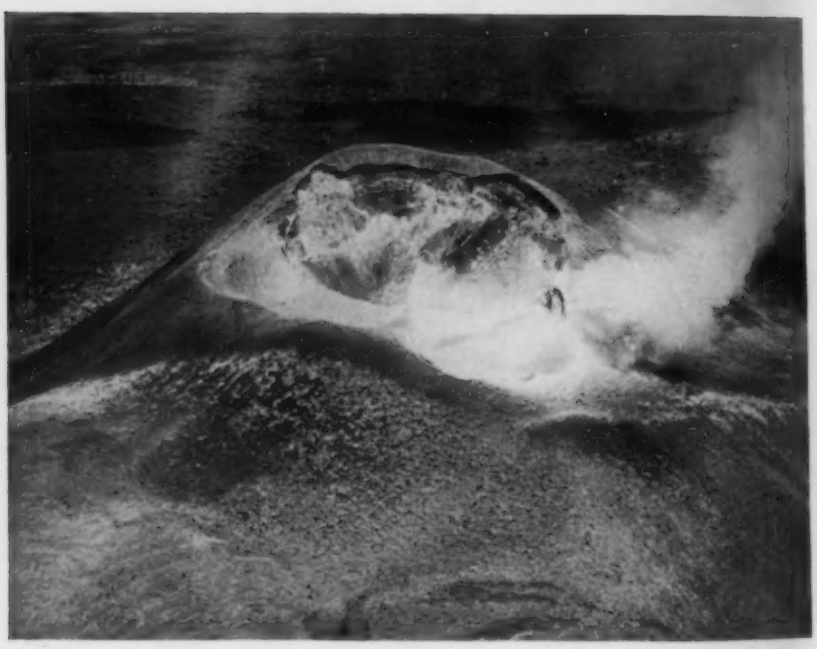

FIG. 3

FIG. 2—Volcán Momotombo, Nicaragua, 4200 feet altitude, about 25 miles northwest of the city of Managua.

FIG. 3—A volcanic peak in the Cordillera de los Marabios which extends for some 50 miles parallel to the coast from the northern end of Lake Managua.

FIG. 4

FIG. 5

FIG. 4—Volcán El Viejo, 5800 feet altitude, the highest volcano of Nicaragua.
FIG. 5—Volcán Coseguina, 2830 feet altitude, on the southern promontory of the Gulf of Fonseca. The hook in the background is Monypenny Point.

be extended, transportation by river boat and coastwise steamer will be improved; but such is the physical make-up of the greater part of Latin America that there will probably always exist great areas over which the modern demand for rapid transportation can only be satisfied by aircraft. The airplane has there found a realm prepared by nature for its enthusiastic reception. The development of air-mindedness has been the least of the problems involved in the establishment of air transportation in Latin America.

Development of Important Routes

Colombia, Mexico, Peru, Bolivia, and the Dominican Republic were the pioneer countries in commercial air transportation in Latin America, with Colombia well in the lead both in point of time and in the success of the venture. An air line established by a French company between Cartagena and Barranquilla in 1919 soon terminated with heavy losses in life and money. But of all the countries of Latin America, Colombia, because of its physical make-up and the shortsightedness of its legislators in laying out plans for railway construction, stood in greatest need of air transportation;[1] and on December 5, 1919, a few Germans resident in Barranquilla together with a number of Colombian citizens formed the Sociedad Colombo-Alemana de Transportes Aereos, popularly known as the "Scadta." In 1920 Dr. Peter von Bauer, a Czechoslovakian, purchased control of the company and has made it one of the outstanding commercial air transportation companies of the world.

The stage was particularly well set. Sectional political interests in Colombia had for years outweighed engineering advice and the best interests of the country as a whole in the matter of railway construction, with the result that the most productive regions of the country had access to the sea only by means of short rail routes to the Magdalena River and thence by steamer, slow at best and subject always to the vagaries of the river, to Barranquilla or Cartagena. When the "Scadta" was organized in 1919 there was no direct route for any of the better developed sections of the country either to the Atlantic or the Pacific ports, but there were thirteen short isolated railways most of which served as feeders to the Magdalena River. The Magdalena is a broad stream suitable for the landing of seaplanes at almost any point, and the first air route established by "Scadta" from Barranquilla to Girardot, the river port for Bogotá, required only good organization and efficient management for its success. Now five additional lines have been established, as given in the appendix to this article, and information obtained directly from the company shows that in 1929 a total of 781,000 miles was flown by scheduled

[1] Cf. R. R. Platt: Railroad Progress in Colombia, *Geogr. Rev.*, Vol. 16, 1926, pp. 82–97.

planes of the company and a total of 5500 passengers and 134,400 pounds of mail transported.

Second only to Colombia in her need for means of transportation among settled areas separated from one another and from the sea by physical barriers of such magnitude as almost to prohibit the construc-

FIG. 6—Arequipa at the foot of El Misti, Peru.

tion of land transportation routes is Peru. Except for two railways from the coast to the plateau—the central railway from Callao to Oroya and the southern railway from Mollendo to Cuzco by way of Arequipa—the railways of Peru consist of short lines connecting the irrigated valleys of the coastal region with near-by ports. Elsewhere in the coastal region, on the plateau, and in the valleys of the eastern border of the Andes transportation is by muleback except for a few roads improved for motor travel. In the eastern lowlands it is by canoe and launch on the navigable rivers. The wealth concentrated in the coastal valleys provides a considerable population who, though reasonably well served by a number of coastwise steamship lines, are financially able to avail themselves of a superior service. The pioneer air transportation company of Peru is the Faucett Aviation Company founded in 1920. It operates along the coast between Lima and Paita and between Lima and Arequipa. Practically the same route is now covered by Pan American-Grace Airways as a part of its line from Cristobal to Montevideo by way of the west coast.

FIG. 7

FIG. 8

FIG. 7—Ruins of the Mayan city of Uxmal, Yucatan.
FIG. 8—Jinotega, capital of the department of the same name, north central Nicaragua.

FIG. 9

FIG. 10

FIG. 9—Progreso, the port of Yucatan.
FIG. 10—Mérida, the capital of Yucatan.

In Peru, mainly for strategic reasons at present but to some extent for commercial purposes as well, the problem of more rapid means of communication between the eastern lowlands and the coast has long been urgent. Now the Peruvian Naval Air Service maintains a regular air route between Iquitos and San Ramón in the Chanchamayo Valley, whence the trip to Lima can be completed in two days by motor road to Oroya and thence by rail. In the north the navy maintains also a line from Moyobamba to Iquitos by way of Yurimaguas; and a new route has now been surveyed from San Ramón to Puerto Maldonado in the Madre de Dios River. *The West Coast Leader* (July 29) reports the projected opening of a line from Pacasmayo, on the Pacific coast some 430 miles north of Callao, via Cajamarca and Chachapoyas to Moyobamba.

In Bolivia, where the problem of connecting the sparsely settled eastern valleys with the centers of population on the plateau is similar to that of Peru, the beginnings of air transportation were laid in 1925 when the German colony at La Paz presented the national government with a Junkers F-3 type plane as a contribution to the centennial celebration of Bolivian independence. The plane, christened *El Oriente*, was turned over to a Bolivian company, the Compañía Lloyd Aereo Boliviano, in which most of the capital was subscribed by Bolivian citizens while the managing and operating personnel were German. Regular service was established for passengers, mail, express, and freight between Cochabamba and Santa Cruz; and five additional routes are now in operation (see appendix). There could be no better evidence of the value of air transportation over such routes than the fact that the trip from Cochabamba to Santa Cruz can now be made in three hours by air whereas it takes from twelve to sixteen days by mule. The trail rises from an altitude of 8435 feet at Cochabamba to 16,000 feet in crossing the eastern range of the Andes to reach Santa Cruz, which is only slightly over 1000 feet above sea level.

In Mexico the first air transportation company, the Compañía Mexicana de Transportación, was organized in Tampico in 1921 by individuals connected with various petroleum companies, its original purpose being the carrying of pay rolls from Tampico to the oil fields some thirty miles distant in order to avoid the robberies which had been for some time a menace to pay rolls carried by land. Passengers were also transported to points within the oil fields, to the oil-loading ports along the coast, and to Mexico City and other cities of the country. The Tampico-Mexico City route was flown as a "taxi" operation until April 15, 1928, when it was opened on a regular mail and passenger schedule. A second company, the Compañía Mexicana de Aviación, S. A., organized in Tampico in 1924, was immediately purchased by the older company.

Before the establishing of air transportation in the West Indies,

travel and the carrying of mails between the various islands was slow, expensive, and in the main a thoroughly discouraging undertaking. Steamers on their way to and from South America and the United States had few ports of call in the islands. In general, interisland communication was by small steamers or sailing vessels. In 1926 two American barnstorming pilots with two small Waco land planes established themselves at San Juan, Porto Rico. At various times they flew across the Mona Passage, a water jump of seventy miles, to the Dominican Republic, attracting thereby the attention of a group of American and Dominican sugar planters who secured their services and equipment and organized a line that by June 1, 1928, was operating between Santiago de Cuba and St. Thomas, Virgin Islands, but on a limited schedule and needing additional capital. Fortunately and opportunely, the United States Government let contracts at this time for the transportation of mail by air between Miami and San Juan, Porto Rico. The company was acquired by an aviation corporation in the United States and became the backbone of what is today the West Indian Division of the Pan American Airways.

The first international air line out of the United States in the direction of Latin America was established in 1919 between Key West and Havana. Though it suspended operations in 1923, its experience proved invaluable to its successors. Pan American Airways commenced service over this route in 1927 and began in the latter part of 1928 to survey and establish air routes between the United States and the countries of Latin America. The work is still under way. During 1929 the company increased its lines from 216 miles to 13,012 miles. Pioneer companies' lines had been acquired and reconstructed, and new routes had been placed in operation until on September 1, 1930, reports showed 5,344,447 miles flown and 30,727 passengers, 1,022,730 pounds of baggage, and over 580 tons of mail transported since January 1, 1929.

Pan American-Grace Airways flies the route down the west coast from Cristobal to Santiago and thence across the Andes to Buenos Aires and Montevideo. Additional extensions made possible by absorption of the New York, Rio, and Buenos Aires Lines by Pan American Airways and the proposed extension of the Curaçao-Venezuela section to Trinidad will complete two great circuits of rapid transport with points of coincidence at Cristobal and Port of Spain. Figure 1 shows the ingenuity of the layout, which is of such flexibility that, in case of a rupture of operations at almost any point, traffic between North and South America can be easily rerouted. In particular this flexibility has in mind the incidence of hurricanes in the region.

The first scheme for linking Europe, Africa, and South America by air was presented to the French government two months before the

FIG. 11

FIG. 12

FIG. 11—Landing field, looking towards the city of San José, Costa Rica.
FIG. 12—Naval airdrome at Governador Island, Bay of Rio de Janeiro.

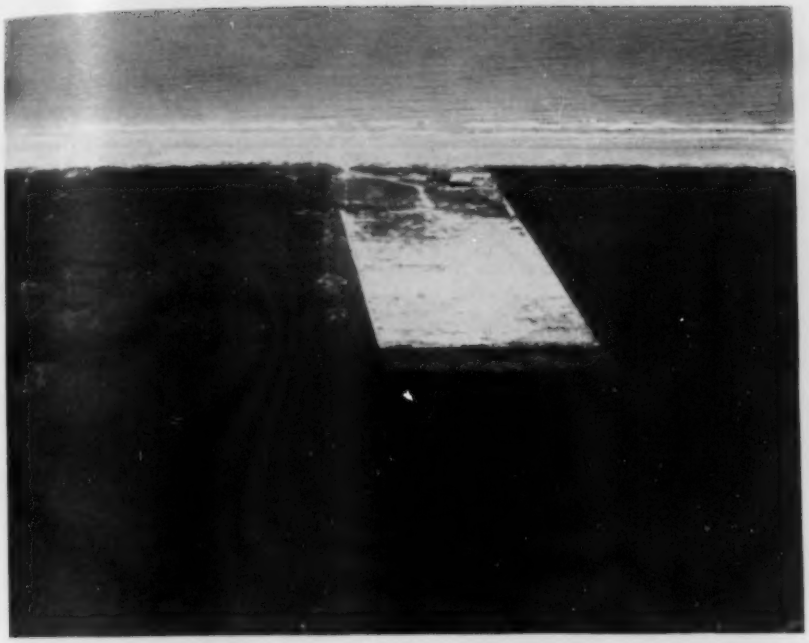

FIG. 13

FIG. 14

FIG. 13—Compagnie Générale Aéropostale landing ground at Santos, Brazil.
FIG. 14—Beach at Santos used as a landing ground.

Armistice was declared; and before the end of the year the first link of the Latécoere Airlines was in operation. In 1921 it was taken over by the newly organized Compagnie Générale Aéropostale. In 1923 engineers and pilots examined and surveyed the route between Natal, Brazil, and Buenos Aires. Late in 1927 the Buenos Aires-Natal route was placed in operation; and on March 1, 1928, the first mail was transported to Natal and thence on fast steamers by way of Fernando de Noronha Island and the Cape Verde Islands to Dakar, Senegal. From there it was carried by plane to Tangiers, Barcelona, Perpignan, Toulouse, Bordeaux, and Paris, the total trip taking seventeen days. This service has been improved until the Buenos Aires-Toulouse trip is now made in nine days and the Toulouse-Buenos Aires trip in seven and a half days, the difference in time being due to the north-south direction of the prevailing winds along the coast of Brazil and to the contrary ocean currents encountered by steamers crossing to the African coast. It is planned to substitute seaplanes for steamers over the ocean gap. Operations of the subsidiary company in the Argentine are given in the appendix.

Another transatlantic service is that of the Condor Syndicate, organized in 1927 by German and Brazilian interests to operate a mail, passenger, and express service along the east coast of Brazil. In February, 1930, the line was extended north to Natal and in March from Natal to Fernando de Noronha Island. There the mail is transferred to fast steamers bound for Lisbon and from Lisbon carried to various points in Europe by airplanes of the Luft Hansa lines. It is now proposed to replace the steamship service by airships.

Character of Routes

In general the most important air routes so far established in Latin America follow navigable waterways whenever possible—for instance the routes of the "Scadta" along the Magdalena, Atrato, and San Juan rivers in Colombia, the S. A. Aéroposta Argentina route up the Paraná River from Buenos Aires to Asunción, and the West Indian route of the Pan American Airways. The generally peripheral character of settlement in South America permits the main trunk-line routes there to follow the coast line on both the Pacific and Atlantic sides. The principal departures from routes along navigable waters are the Tampico-Veracruz-Guatemala line of the Pan American Airways and the various short crossings of the Andes in Colombia, Peru, Bolivia, Chile, and the Argentine Republic.

Natural conditions are of first consideration in the selection of flying equipment, and value of traffic second. Multimotored amphibians and seaplanes are used on the Cuba-Yucatan water jumps, and along the low coasts of northern and western Colombia and of

Brazil. Trimotor land planes are used on the West Indian lines with their short water jumps, on the routes through the high mountainous regions of the Pacific coast of Central America, and from Santiago de Chile to Buenos Aires. Single-motored seaplanes have been found very adaptable to the river routes of Colombia and Panama where water landings are always available. Single-motored land planes are used on the high table-lands of northern Mexico and in Peru and Chile where the Andes rise precipitously from the sea.

Meteorology and Surveying

Of great interest to the geographer in connection with the establishment of air transportation routes in Latin America is the necessity of continuous and adequate weather reports by means of radio to landing stations and planes in flight. Intermediate weather-observation stations with radio facilities must be maintained at all critical points if flying is to be safe. Most air lines in the Caribbean, in Central America, and on the east coast of Brazil have excellent radiotelegraph facilities and are steadily improving them. The Pan American Airways has now forty-eight ground stations in operation and twenty-two others under consideration. Over this network weather reports are flashed constantly, and every plane always has full information on weather conditions along its scheduled routes. The records from these critically located stations will be of the greatest value to students of the climate and weather of the Latin American countries.

Another important development which in many of the countries of Latin America has accompanied the establishing of air transportation is the use of the aerial camera in survey work. The "Scadta" company in Colombia is the pioneer in this field. The company maintains a regular division for aerial surveys and has already made extensive contributions to the cartography of Colombia. Of especial interest among these are a survey of the Magdalena River from Neiva to its mouth (a distance of 1200 kilometers) made for a German company engaged in studying the canalization and control of the river, a survey of the upper tributaries of the Catatumbo River for the Swiss Commission on the Colombia-Venezuela boundary, a survey in 1929 of the Colombia-Panama boundary zone, and a number of surveys of large areas in the Magdalena Valley for American petroleum companies. In Peru aerial surveys are being used for the study of road and railway routes and irrigation projects and for speeding the work on the new Carta Nacional which is being produced by the Geographical Service of the Peruvian Army. In Bolivia, Chile, and the Argentine Republic aerial surveys have now a definite place in the various schemes of systematic surveys in which various departments of the government are engaged.

APPENDIX: AIR TRANSPORT COMPANIES IN LATIN AMERICA, CHARACTER AND ROUTES

The Pan American Airways System

Routes maintained by the Pan American Airways:

1.	Miami, Nassau	193 miles
2.	Miami, Camagüey, Santiago, Port-au-Prince, Santo Domingo, San Juan, St. Thomas (Virgin Islands), St. Johns (Antigua), Port Castries (St. Lucia), Port of Spain, Georgetown, Nickerie, Paramaribo, Montenegro, Pará, São Luiz, Fortaleza, Natal, Bahia, Caravellas, Rio de Janeiro, Santos, Montevideo, Buenos Aires	7,108 miles
3.	Havana, Camagüey	319 miles
4.	Miami, Havana, Cozumel Island, Belize, Tela, San Salvador, Managua, Punta Arenas (Costa Rica), David (Panama), Panama, Cristobal, Cartagena, Barranquilla, Maracaibo, Curaçao, La Guayra (Venezuela)	3,298 miles
5.	Miami, Havana, Puerto Cabezas (Nicaragua), Cristobal	1,412.5 miles
6.	Punta Arenas (Costa Rica), San Jose	60 miles

Routes maintained by the Compañía Mexicana de Aviación, S. A.:

1.	Brownsville (Texas), Tampico, Veracruz, San Geronimo, Tapachula, Guatemala City, San Salvador	1,256 miles
2.	Brownsville, Tampico, Tuxpan, Mexico City	501 miles
3.	Veracruz, Campeche, Mérida (Yucatan)	521 miles

Route maintained by the Pan American-Grace Airways, Inc.:

	Cristobal, Las Palmas (Panama), Buenaventura, Tumaco, Santa Elena, Guayaquil, Talara, Piura, Pimentel, Trujillo, Lima, Arequipa, Arica, Antofagasta, Ovalle, Santiago de Chile, Mendoza, Buenos Aires, Montevideo	4,522 miles
Total		19,190 miles

Corporación Aeronautica de Transportes, S. A. (Mexico)

This company operates mail, passenger, and express services southward from Nogales, Ciudad Juárez, and Matamoros, respectively. The Matamoros-Mazatlán line was inaugurated in March, 1929, on a biweekly basis. The lines from Ciudad Juárez and Nogales were organized in August, 1929, and now afford a daily service and cover their routes in twelve hours. The routes are as follows:

1.	Matamoros, Monterrey, Torreón, Durango, Mazatlán	638 miles
2.	Ciudad Juárez, Chihuahua, Parral, Torreón, Zacatecas, León, Mexico City	1,104 miles
3.	Nogales, Cananea, Nacozari, Chihuahua	345 miles
Total		2,087 miles

Compañía Aereo Honduras (Honduras)

This company, an air-transport subsidiary of the United Fruit Company, was formed in 1928 and transports mail, passengers, and express over the following route:

	Tela, San Pedro, Tegucigalpa	166 miles

Isthmian Airway

On December 31, 1929, this company (organized May 5, 1929) reported 89,000 miles flown and 4111 passengers and 125,054 pounds of express and baggage carried over the following route:

Cristobal, Balboa	47 miles

Sociedad Colombo-Alemana de Transportes Aereos (Scadta)

1. Magdalena line—Barranquilla, Girardot, Bogotá (daily; mail alone transported between Girardot and Bogotá)	650 miles
2. Santander line—Barranca Bermeja, Puerto Wilches, Bucaramanga	90 miles
3. Interoceanic line—Barranquilla, Sautata, Quibdo, Buenaventura, Tumaco, Guayaquil (weekly)	1,200 miles
4. Atlantic line—Santa Marta, Barranquilla, Sautata, Cristobal (weekly)	500 miles
5. Transandean line—Bogotá, Girardot, Ibagué (biweekly, for mail only)	90 miles
Total	2,530 miles

Faucett Aviation Company (Peru)

Arequipa, Mollendo, Iça, Lima, Chimbote, Trujillo, Pacasmayo, Chiclayo, Paita	1,200 miles

Peruvian Naval Air Service

1. San Ramón, Puerto Bermudez, Masisea, Contamana, Orellana, Requena, Iquitos (biweekly)	800 miles
2. Moyobamba, Yurimaguas, Iquitos (biweekly)	300 miles
Total	1,100 miles

Chilean War Department Air Service

This is a mail, passenger, and express service:

Arica, Iquique, Antofagasta, Copiapó, Ovalle, Coquimbo, Santiago, Puerto Montt, Puerto Aysen, Magallanes (triweekly, Arica to Puerto Montt, weekly to Magallanes)	2,900 miles

Compañía Lloyd Aereo Boliviano (Bolivia)

1. Cochabamba, Vallegrande, Santa Cruz (weekly)	274 miles
2. Santa Cruz, Puerto Suárez (monthly)	469 miles
3. Cochabamba, Sucre (weekly)	150 miles
4. Santa Cruz, Yacuiba (monthly)	375 miles
5. Cochabamba, Todos Santos (fortnightly)	135 miles
6. Todos Santos, Riberalta (monthly)	625 miles
7. Cochabamba, Oruro, La Paz (weekly)	236 miles
Total	2,264 miles

Condor Syndicate (Brazil)

1. Southern Division—Rio Grande do Sul, Porto Alegre, Rio de Janeiro (biweekly)	935 miles
2. Northern Division—Rio de Janeiro, Bahia, Natal, Fernando de Noronha	1,511 miles
Total	2,446 miles

Compagnie Générale Aéropostale (Latécoere)

The operations of this company are conducted under its own name between Buenos Aires and Natal and also in Venezuela, while the S. A. Aéroposta Argentina is the operating subsidiary in the Argentine Republic. Mail, passengers, and express are transported by these two companies over the following routes:

1.	Compagnie Générale Aéropostale—	
	a. Buenos Aires, Montevideo, Pelotas, Porto Alegre, Florianopolis, São Francisco, Paranagua, Santos, Rio de Janeiro, Caravellas, Victoria, Bahia, Maceio, Pernambuco, Natal (weekly)	2,895 miles
	b. Maracaibo, Maracay, Ciudad Bolivar (Venezuela) (biweekly)	589 miles
2.	S. A. Aéroposta Argentina—	
	a. Buenos Aires, Mar del Plata	240 miles
	b. Buenos Aires, Bahía Blanca, San Antonio, Trelew, Comodoro Rivadavia, Puerto Deseado, San Julian, Santa Cruz, Rio Gallegos (biweekly)	1,650 miles
	c. Buenos Aires, Rufiño, Villa Mercedes, Mendoza, Santiago de Chile (weekly)	750 miles
	d. Buenos Aires, Concordia, Monte Caseros, Posadas, Asunción (biweekly)	690 miles
Total		6,814 miles

AN OLD ESKIMO CULTURE IN WEST GREENLAND

REPORT OF AN ARCHEOLOGICAL EXPEDITION TO UPERNIVIK

Therkel Mathiassen

National Museum, Copenhagen

AS an introduction to a systematic archeological survey of Greenland the Ministerial Commission for Scientific Investigations in Greenland instructed the writer to carry out excavations in West Greenland in the summer of 1929.[1] Upernivik district was chosen as the field of operations. The most northerly district in West Greenland, it has an especial interest as being the first place occupied by the Eskimos migrating into the country. Furthermore, I had received information about a particular site, the island of Inugsuk, which made me wish to investigate it as soon as possible. Dr. Holger Andersen, district physician in Upernivik in 1927–1928, in presenting the National Museum with a collection of 150 specimens from Inugsuk, directed my attention to this place. Here, he reported, was an Eskimo kitchen midden about two meters thick, which the sea was fast washing away. The late Pastor Rossen of Upernivik thought he had found at Inugsuk a Norse dwelling site. And the Norsemen had built a beacon on the neighboring island of Kingigtorssuaq and made a runic inscription on a stone which was brought to the National Museum over a century ago.

The expedition proved most successful. The find at Inugsuk gives us an idea of how much interesting scientific material lies hidden in Greenland's frozen soil, holding the key to many unsolved problems of the country and its Eskimo population.

During the past ten years special interest has been aroused in Eskimo archeology. Dr. Knud Rasmussen's Fifth Thule Expedition conducted archeological investigations in the central part of the territory occupied by the Eskimos, especially north and west of Hudson Bay. They led to the discovery of the now vanished Thule culture.[2] Canadian expeditions made excavations along the eastern

[1] The expenses were defrayed partly by the government and partly by the Carlsberg Fund. Miss Frederica de Laguna, a student of Columbia University, New York, served as volunteer assistant.

[2] Therkel Mathiassen: Archaeology of the Central Eskimos (Rept. of the Fifth Thule Expedition, 1921–24, Vol. 4), 2 vols., Copenhagen, 1927. A short summary by the same author is given in the *Geogr. Rev.*, Vol. 15, 1925, pp. 544–549.

shores of Hudson Bay, which gave Jenness the material upon which he based his Cape Dorset culture.[3] Later, Jenness himself excavated at Bering Strait, where he traced a third old culture, the Bering Strait culture.[4] Still later, American expeditions—of Putnam, Collins, and others—have excavated at different places in the American Eskimo territory;[5] and the interesting Van Valin collection in Philadelphia from Point Barrow has given an important datum in the archeology of the western area. The eastern extremity, Greenland, has been very little investigated archeologically. The most carefully studied region is, curiously enough, the now uninhabited northeast, and nearly all the material from it has been described; yet even there systematic excavation by professional archeologists is lacking. In the Cape York district the find from Comer's Midden is the datum. Of the archeology of the Angmagssalik district of the southeast absolutely nothing is known, and very little, too, of West Greenland. The only place where excavation on a considerable scale has been made is Sermermiut near Jakobshavn, but the material from here has not been described. It is true that in museums, especially in the National Museum in Copenhagen, are found large collections of West Greenland antiquities, but they have been mostly acquired through chance finds rather than from systematic investigations. Archeological material from West Greenland has been described by Solberg[6] (stone implements), Swenander[7] (harpoon and arrow heads), Porsild,[8] and Birket-Smith.[9] A recently published paper by Thomsen[10] is a review of our knowledge of the archeology of Greenland and shows how defective it really is. The following account is a preliminary report of my expedition of last year.[11]

The Site at Inugsuk

The island of Inugsuk is situated about 20 kilometers north of Upernivik and a little back from the open sea. A small bay cuts into

[3] Diamond Jenness: A New Eskimo Culture in Hudson Bay, *Geogr. Rev.*, Vol. 15, 1925, pp. 428–437.

[4] *Idem:* Ethnological Problems of Arctic America in "Problems of Polar Research: A Series of Papers by Thirty-one Authors," *Amer. Geogr. Soc. Special Publ. No. 7*, New York, 1928, pp. 167–175.

[5] H. B. Collins, Jr.: Prehistoric Art of the Alaskan Eskimo, *Smithsonian Misc. Colls.*, Vol. 81, No. 14, Washington, 1929.

J. A. Mason, in *Proc. 23d Internatl. Congr. of Americanists Held at New York, 1928.*

Therkel Mathiassen: Archaeological Collections from the Western Eskimos (Rept. of the Fifth Thule Expedition 1921–24, Vol. 10), 1930.

[6] O. Solberg: Beiträge zur Vorgeschichte der Osteskimo, Christiania, 1907.

[7] Gustaf Swenander: Harpun-, kastpil- och lannspetsar från Väst-Grönland, *Kungl. Svenska Vetenskapsakademiens Handlingar*, Vol. 40, No. 3, 1906.

[8] M. P. Porsild: Studies on the Material Culture of the Eskimo in West Greenland, *Meddelelser om Grønland*, Vol. 51, 1915, pp. 111–250.

[9] Kaj Birket-Smith: Ethnography of the Egedesminde District, with Aspects of the General Culture of West Greenland, *ibid.*, Vol. 66, 1924.

[10] Thomas Thomsen: Eskimo Archaeology, in "Greenland", Vol. 2, Copenhagen and London, 1928, pp. 271–329.

[11] The writer left for the field again in May.

the south side of the island and is fronted by two small islands, Sangmissoq and Tunungassoq, forming a good natural harbor sheltered from all winds. Around the bay are several remains of Eskimo habitations. On the southeast point of Inugsuk itself (in the church register at Upernivik called "Inugsuk") are found three house ruins and some graves, but these ruins are not very old. One of them seems to have

FIG. 1—Inugsuk Island. The tents are pitched on the south end of the kitchen midden.

been inhabited for a few years during the last decade of the nineteenth century, while the others are known to have been inhabited from 1835 to 1855. On the west side of the harbor at a locality called Qamaneq are also three ruins, two quite new, which were inhabited in the eighteen-forties and fifties, and the third, a long communal house, of the type used in the eighteenth century. On the island Sangmissoq are two ruins, probably dating from the middle of the nineteenth century, and some graves.

The main interest, however, attaches to Tunungassoq, the more easterly of the two islands, a rock measuring 120 by 80 meters and about 20 meters high. At the foot of the northern end of a long cliff that forms the western side of the island lies a strip of low ground, 43 meters long and 14 meters broad in its widest part, consisting of a moraine bank covered with the refuse of an ancient Eskimo village site. The sea has cut into this midden, forming a cliff along its outer edge that in certain places has a height of over two meters above the stony beach. On the rock cliff to the south are ledges with midden remnants, showing that the refuse heap once stretched farther in this direction: it probably also stretched towards Sangmissoq, which

at very low tide is connected with Tunungassoq. The land here is sinking, and most of the original midden has been washed away by the sea. It has left, however, many bones and implements lying among the stones of the beach.

On the midden are situated the remains of three house ruins; or, rather, they were so situated, for two of them were already almost washed away when I began to excavate, and these were completely demolished during the excavation. The third ruin, a large square house with high stone walls and the doorway partly intact, I tried to preserve. The excavation of this ruin and the remnants of the two others showed that these houses were not very old, hardly older than the eighteenth century; and, in any case, the big house seems to have been inhabited until some time in the nineteenth century, as glass beads, gun flints, fragments of crockery and china, clay pipes, and imported hardware show. It yielded, however, a rich find of Eskimo material exhibiting the fully developed West Greenland culture, only a little more old-fashioned than that which exists today. The upper layer of the midden, from 10 to 50 centimeters in thickness, is composed of refuse from these ruins and thus yields the same modern cultural types; but below this comparatively recent layer lies a thick deposit from a much older Eskimo culture. This old midden gives the find at Inugsuk its significance.

FIG. 2—Looking down on the Inugsuk midden where are seen the best preserved of the newer house ruins.

THE KITCHEN MIDDEN

The layers of the old midden had in certain places, especially close to the outer edge, a thickness of more than one and a half meters.

while at other places they were only 20 centimeters thick. The refuse layers were typical of an ordinary old Eskimo midden: they contained large numbers of animal bones, especially those of seals, whales, white whales, and caribou; and also walruses, narwhals, bears, dogs, foxes, birds, and fish.

Very prominent in the midden, especially in its lower part, was baleen, which in certain places was heaped together in thick layers. Stone implements are not very numerous, because of the lack of suitable material in the neighborhood. Of metal a single piece of copper was found, and a few iron blades for harpoon heads and knives. The iron is probably meteoric, occurring in the Cape York district, or telluric from southern West Greenland. Wooden implements are very numerous and are made of driftwood or local Greenland timber. Besides, there were found turf, stones, waste from the manufacture of implements, ashes, charred wood, heather, straw, hair, feathers, scraps of skin, dogs' excrement—the whole soaked with blubber and cemented into a conglomerate or lumped in sticky masses. The ruins of the houses from which the refuse derives were not found, but we uncovered several remnants of floors or platforms, made of regular flat paving stones, over which there was often a layer of heather, while the earth below was saturated with blubber. These stone pavements gave no definite information about the size or shape of the houses.

The find from Inugsuk comprises altogether 5300 specimens. Of these about 3700 come from the old midden. It is these specimens that are discussed here.

Relation of the Find to the Thule Culture

A preliminary analysis of the types of implements found in the old midden shows that, of the 181 or so types which it contains, 146 or about 80 per cent are known from the ancient Central Eskimo culture, which I have described in an earlier work under the name of "Thule culture." Of these 146 types about 25 are among the most representative forms of that culture. But besides these well known Thule types the find contains 14 which probably belong to the Central Thule culture but which, by accident, have not been found there. Of the remaining 21 types quite foreign to the Thule culture, 6 are also known outside Greenland but are younger than the Thule culture, 11 are local Greenland forms, and of these 4 are quite new. These figures indicate with great certainty that the find is very closely related to the Thule culture; but the last three groups of types give it individuality. They show that it is younger and that there has already begun a development towards the later specialized West Greenland culture. This stage of culture will be called the Inugsuk culture.

FIG. 3

FIG. 4

FIGS. 3 and 4—Implements from the Thule culture, Inugsuk.

Figure 3 shows: 1–5, harpoon heads; 6, arrowhead; 7, wound pin; 8, gull hook; 9, side prong for bird dart; 10–12, stone weapon points; 13–14, stone scrapers; 15, slate *ulo* blade; 16, stone drill point; 17–19, bodkins; 20, ivory chain; 21–23, dolls; 24–25, stone pendants; 26, comb; 27, amulet box; 28, toy lamp; 29, winged needlecase. About one-quarter natural size.

Figure 4 shows: 1–2, harpoon foreshafts; 3, harpoon socket piece; 4, ice pick; 5, bow; 6–7, snow knives; 8, bola ball; 9, drill mouthpiece; 10, stone adz blade; 11, sealing scratcher; 12–13, knife handles; 14, adz head; 15, scraper cup; 16, baleen shaver; 17, *ulo* handle; 18, snow probe (probably); 19, two-handled scraper; 20, wedge; 21, comb; 22, spoon; 23, oval cup (bottom); 24, hammer stone. Between one-seventh and one-eighth natural size.

Of the harpoon heads the typical Thule forms, thin with open socket, are quite numerous, but they are not predominant: another old type, thin with closed socket and blade parallel with the line hole, is met with most frequently—a type that also occurs, but sparsely, in the Central Thule finds. A few flat harpoon heads are also found, both with open and closed socket. There are blades for harpoon heads of bone, stone, and ivory. The foreshafts for kayak harpoons all belong to the old type with conical end and single, central line hole; and with these are associated the heavy socket pieces. Ice-hunting harpoons are represented by the foreshafts and the ice picks. Wound pins, an implement hitherto unknown in West Greenland, are very numerous. The sealing stool was to be expected, but the sealing scratcher, still used in Alaska for the *Utoq* hunting of seals, is new for Greenland. Four of these were found at Inugsuk. There are bow staves of baleen and wood, and numerous arrowheads with conical tang, furnished with two knobs, never with a screw. The side prongs for bird darts, in contrast to those of the Central Thule finds, nearly all have barbs on the inside only, like the modern form.

Bola balls are for the first time found in Greenland. Gull hooks are very numerous. Fishing implements are rare, because the place offers poor fishing and is far from salmon rivers. Many sledge crossbars, shoes of whalebone and baleen, trace buckles, and whip handles occur. The snow knives all belong to the broad type with one shoulder. The knives comprise the type with end blade and the type with several small lateral sockets, which sometimes fuse together into one long groove for a

row of stone or metal chips. Whetting stones, adz heads and handles, the different parts of the bow drill, wedges, mattocks, and *ulos* are of the types commonly occurring in the Thule culture. For the first time in Greenland are found the small baleen shavers, well known from Alaska. Of scrapers we have some small flint blades and numerous examples of a hitherto unknown type, made of a leg bone (caribou, seal, bear) split lengthwise, forming a hollow trough with sharpened edges, while the articulations at both ends serve as handles. They were probably used as a kind of fat scraper, similar to the cup-shaped scraper which also occurred in the finds. Two-handed scrapers are represented by a few specimens from Northeast Greenland but are elsewhere not very common in the Eskimo culture. We have the "winged" needlecase, the skin thimble, and the anchor-shaped thimble holder; a series of handsome bodkins, most often ornamented with encircling ridges at the head, and a single one with a chain link. The lamps are mostly of the Thule type with a ridge close to the fore edge. The cooking pots are of soapstone and are rounded. Cups and bowls of baleen are numerous, and trays and bowls hollowed out of wood.

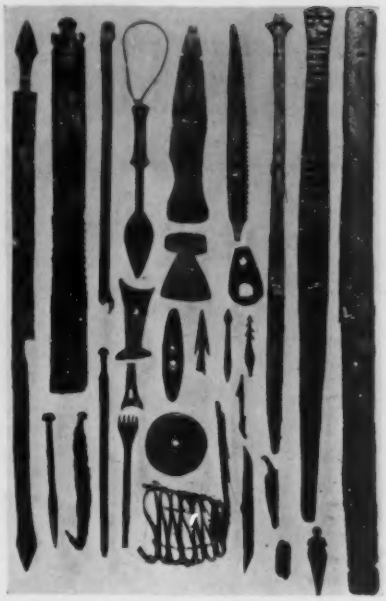

FIG. 5—Baleen implements from Inugsuk, including: bow, sledge shoe, snow beater, drill bow, dagger, saw, trace buckle, wound pin, fishhook, top, many toys. About one-eighth natural size.

In contrast to the earlier finds we have examples of coopery. Staves of small wooden tubs are very common, and a complete little tub with baleen hoops was found. Spoons, often with pretty openwork handles, wooden dippers, meat sticks, pothooks, and blubber pounders complete the list of household utensils. Pieces of drilled wood show the method of making fire. There are many platform mats of baleen, well known from the earlier Thule finds. Of clothing only a pair of sealskin mittens was found. Snow beaters of baleen, often nicely shaped, are common. The combs have a narrow grip, often with incised or openwork decoration. The skin ball and the louse catcher, a wooden stick with a bundle of bear hairs at the end, are found here for the first time in so old a culture. Of ornaments we have some drop pendants of ivory and stone, and a single stone bead. A wooden bear is the only animal figure.

Dolls of wood and ivory in the usual old style without arms and with flat featureless face are numerous. One of them has the same cross on the breast and back as is found on two dolls from Repulse Bay and Baffin Land, crosses which I have interpreted as amulet straps, similar to those of the Angmagssalik Eskimos. Some of the dolls have hair knots, recalling the Cape York Eskimos. Ajagaqs are quite common and are of several different shapes. The many toys copy almost every article known in the adult culture—weapons, tools, utensils—besides including tops, buzzes, etc. Amulet boxes, well known from Western and Central Eskimo archeology, are also found here. Finally, we have numerous examples of the unknown implement of wood with elaborately carved handle, earlier described from Northeast Greenland and Baffin Land. Decorated objects are rare, but a few are found. The designs are dots, simple lines, zigzag lines, and a familiar motif from the Thule culture.

The Inugsuk find forms a new important link in the long row of Thule culture finds indicating the route followed by the Eskimo migration from Alaska over the Canadian Arctic to Greenland and represented by the datum points of: Point Barrow in Alaska, Malerualik on King William Island, Naujan in Repulse Bay, Qilalukan on northern Baffin Land, and Comer's Midden in Northwest Greenland. The Inugsuk find is probably the youngest link in this chain. This migration of the Thule Eskimos towards the east I regard—as I have discussed elsewhere[12]—as the first spread of the Eskimos from the west via the central regions to Greenland. It is, however, a question if the find from Inugsuk represents the first Eskimo culture that penetrated into West Greenland by Melville Bay; it is not improbable that an earlier phase of the Thule culture may be found, though as yet there has not been found in West Greenland any older stage.

FIG. 6—Specimen found at Inugsuk showing connection with Norsemen. Lump of church bell metal. Natural size.

The question, however, may be raised as to whether the more pronounced stone culture, of which we have traces in Disko Bay[13] (Sermermiut, Qeqertaq), is not still older than Inugsuk. I do not, however, believe that such is the case. Most of the types of this culture are known from Inugsuk, even though only in a few specimens. As I have already stated, the rarity of stone implements is explained by the difficulties of getting suitable material: whereas in Disko Bay there are unlimited resources of chalcedony, jasper, and especially siliceous slate (*angmaq*), derived from the basalt area, which is lacking in the northern Upernivik district. Parallels can be drawn from other Thule finds: at Ponds Inlet the plentiful occurrence of slate has produced many stone implements, while they are rare in the Cape York district, where meteoric iron was used as a substitute. Since the Inugsuk culture has descended from the old Cape York culture,[14]

[12] Therkel Mathiassen: Spørgsmaalet om Eskimokulturens Oprindelse, *Geogr. Tidsskrift*. Vol. 32, 1929, pp. 116–126. The same paper, "The Question of the Origin of Eskimo Culture," will be printed in the *American Anthropologist*.

[13] Solberg, *op. cit.*

[14] Clark Wissler: Archaeology of the Polar Eskimo, *Anthropol. Papers Amer. Museum of Nat. Hist.*, Vol. 22, 1918, pp. 105–166; and Mathiassen, Archaeology of the Central Eskimos, Vol. 1, pp. 293–304.

it is only natural that its stone technique should be poorly developed; but the first step towards the rich "stone age" culture in Disko Bay had already been taken. On the other hand the Inugsuk people had access to iron, even in considerable quantities. From Cape York it was possible to get meteoric and from the basalt in Disko Bay telluric iron; and, besides, there seems to have been a third source, which will be discussed below.

FIG. 7—Specimen found at Inugsuk showing connection with Norsemen. Small wooden doll carved by an Eskimo but representing a Norseman. Two-thirds natural size.

THE AGE OF THE INUGSUK FIND

How old is the Inugsuk find? It has not been possible to set an exact date for the Central Thule finds, but through the rising of the land it was possible to date them relatively. This has led to the suggestion that the oldest of them is about a thousand years old and that the youngest of them, Ponds Inlet and Comer's Midden, are a few hundred years younger. In Greenland this criterion is useless, for the land is sinking in most places, including the northern part of the west coast. But here we have another clue.

Deep down in the old midden—which contains no glass beads or other signs of contact with the old whalers—were found a few objects apparently derived from the Norsemen who inhabited southern Greenland in the Middle Ages. These things are: a lump of church bell metal, a mixture of about 76 per cent copper and 23 per cent tin, used as a hammer; a piece of coarsely woven cloth; and three wooden carvings—two dolls and a face. One of the dolls is small, carved in the ordinary Eskimo style without arms and face features; but it is no Eskimo; it has the long dress with narrow waist and hood which Dr. Nørlund found in his excavations on the old Norse churchyard at Herjolfsnes in South Greenland in 1921 and which was in general use in Europe during the Middle Ages.[15] The other doll has certain features in common with this one, but the face, elaborately carved, has features that do not in the least resemble an Eskimo countenance; and on the other side this wooden piece has an ornament absolutely unknown in the Eskimo culture but familiar to the Norsemen, as is shown by a wooden board from a coffin at Herjolfsnes.[16]

[15] Poul Nørlund: Buried Norsemen at Herjolfsnes; An Archaeological and Historical Study, *Meddelelser om Grønland*, Vol. 67, 1924, pp. 1–270; see Figures 66, 72, 89, and 130. See also William Hovgaard: The Norsemen in Greenland: Recent Discoveries at Herjolfsnes, *Geogr. Rev.*, Vol. 15, 1925, pp. 605–616.

[16] Nørlund, *op. cit.*, Fig. 32.

There must assuredly have been some connection between the Thule Eskimos and the medieval Norsemen, and this connection has been found as far north as Upernivik district. We know that the Norsemen actually went up there. Mention has already been made of the runic stone found in a cairn on the island of Kingigtorssuaq, neighbor to Inugsuk. The inscription on this stone reads "Erling Sigvatsson and Biarni Thordsson and Enridi Oddsson erected this cairn Saturday before soccage (25th April) and . . . "[17] And Professor Finnur Jónsson says that, judging by the language, it must derive from the second half of the thirteenth century. It is tempting to connect this visit with the things found at Inugsuk, and if this surmise is correct the layers of the midden in which these things were found—from halfway down to the bottom—must derive from that time. This does correspond very fairly with the suggested age of the Thule finds in the Canadian Arctic, a suggestion that was merely guesswork. It is the Inugsuk find that gives us thus a real idea of the time elapsed since the Thule culture existed in North Greenland.

Of course it is not impossible that the metal and the cloth were trade goods from the south; but the dolls and the other carvings seem to indicate that the inhabitants of Inugsuk had seen Norsemen. And there are other evidences of contact in the coopery objects—staves of wooden tubs and a complete tub with baleen hoops—in the old midden at Inugsuk, found close to the bottom layers. Coopery is else unknown to the Eskimo culture and, as a matter of fact, to the whole of pre-Columbian America; but it was well known in medieval Europe, and the most natural explanation is that the Eskimos learned it from the Norsemen. The form of the antler spoons at Inugsuk likewise suggests familiarity with European medieval spoons. Probably some of the iron is also of Norse origin: we know that the Norsemen obtained iron locally,[18] hence the metal was then probably not so precious to them as was formerly supposed. There is still more evidence, which I cannot enter upon in this preliminary report.

How far south the Thule culture reached in West Greenland we do not yet know; but somewhere here it met another and quite different culture—that of the medieval Norsemen. The two cultures influenced each other in some degree, and a result of this contact was the Inugsuk culture; but in the course of time the Eskimos got the upper hand, extinguished the Norse culture—and probably the people too—and settled down in that land in which they seemed to prosper.

[17] Daniel Bruun: The Icelandic Colonization of Greenland and the Finding of Vineland, *Meddelelser om Grønland*, Vol. 57, 1918, p. 106.

[18] Niels Nielsen: Evidence on the Extraction of Iron in Greenland by the Norsemen, *Meddelelser om Grønland*, Vol. 76, 1929.

THE ORIGIN OF THE IRISH "ESKERS"*

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THE great ridges, broad hummocky complexes, and isolated hillocks of sand and gravel that rise sharply above the monotonous surface of the central lowland of Ireland and form the most conspicuous features of its landscape have attracted the attention of travelers for generations. Primitive fortifications, *raths*, were built upon their summits, and the crests of many still support the ruins of castles. One long ridge was used by pilgrims as a path that enabled them to avoid traversing the boggy lowlands along the River Shannon. The native people have called these features by the name of *esker* at least since the beginning of the Christian era. According to some the word is derived from the Gaelic *aisgir*, according to others from the Irish *eascra*.

The Term "Esker"

Long after the establishment in Ireland of a systematic geological survey, and long after the publication of Louis Agassiz' glacial theory, these curious forms were thought by scientific men to be bars and beaches thrown up by the waves of a great diluvial sea.[1] One enthusiastic writer, inspired by Darwin's work on coral reefs, went so far as to classify them into *fringe eskers*, *bar or barrier eskers*, and *shoal eskers*. Modern study of such forms began in the seventies, and the first modern discussion of the Irish forms was undertaken by Sollas in 1896.[2]

The first technical use of the term *esker* was made by Close[3] in 1867, who applied it to ridges of stratified material as distinguished

* Examination of the "eskers" and other glacial deposits in northern Europe in the summer of 1929 was made possible for the writer by a grant from the Dana Research Fund of Yale University. The hospitality and cordial coöperation of Professor J. Kaye Charlesworth of Queen's University, Belfast, of Professor H. J. Seymour of the National University, Dublin, and of T. Hallissy, Esq., of the Geological Survey of Ireland, are gratefully acknowledged.

The word *esker* is inclosed in quotation marks throughout this discussion because its use in Ireland is inconsistent with its use in America.

[1] R. L. Praeger: A Bibliography of Irish Glacial and Post-glacial Geology, *Proc. Belfast Naturalists' Field Club*, Vol. 2, 1895–96, App., pp. 239–316. (Contains complete list of titles published prior to the contribution by Sollas (1896), mostly based on the early marine hypothesis.) See also *Geol. Survey of Ireland, Sheet Memoirs*, Nos. 1– , 1858–

[2] W. J. Sollas: A Map to Show the Distribution of Eskers in Ireland, *Sci. Trans. Royal Dublin Soc.*, Vol. 5 (Ser. 2), 1895–96, pp. 785–822.

[3] Maxwell H. Close: Notes on the General Glaciation of Ireland, *Journ. Royal Geol. Soc. of Ireland*, Vol. 1, 1864–67, pp. 207–242.

G. A. J. Cole and T. Hallissy: Handbook of the Geology of Ireland, London, 1924.

from hills of till, which he termed *drumlins*. Hummel[4] in Sweden and N. H. Winchell[5] in America suggested that ridges of stratified drift were the casts of glacial streams. T. C. Chamberlin[6] proposed the use of the Swedish term *ås* (plural *åsar*), changed somewhat arbitrarily to *osar* (plural *osars*), for eskers that trend in the general direction of the local ice movement and the application of the Scottish word *kame* for masses of gravel elongated transverse to the ice movement. As the interpretation of elongate ridges of stratified glacial débris as casts of glacial streams gradually spread among American investigators, the term *esker* clung to them until, without the impetus of a single definite proposal, it became permanently fixed. As the situation stands at present, therefore, in America the term *esker* is restricted to sinuous ridges of gravel and sand believed to have been deposited by glacial streams; in Ireland it refers to all mound- or ridge-like accumulations of stratified material; in Scandinavia it is not used at all, being replaced, in the American sense, by *ås*; and in Great Britain it is being superseded by *osa*.

FIG. 1—Glaciation of Ireland during the régime of the Last Ice Sheet. Dotted line—limit of ice-cap glaciation at this epoch, by Scottish ice, and by ice from two Irish centers (arrows show approximate directions of ice movement). Broken lines—limits of local glaciation by valley glaciers in highlands south of the main ice mass (each local center named).

THE GLACIATION OF IRELAND

Ireland consists of three distinct regions. The irregular northern upland is sculptured variously from resistant metamorphic rocks, resistant folded sedimentary rocks, and resistant intrusives and basalt flows: its summits reach elevations of more than 2000 feet. The southern upland, carved chiefly from resistant folded strata, is com-

[4] D. Hummel: Om rullstenbildningar, *K. Svenska Vetenskapsakad. Bihangtil Handl.*, Vol. 2, 1874, No. 11.

[5] N. H. Winchell: The Surface Geology of North-Western Ohio, *Proc. Amer. Assn. for the Advancement of Sci.*, Vol. 21, 1873, pp. 152–186.

[6] T. C. Chamberlin: Terminal Moraine of the Second Glacial Epoch, *U. S. Geol. Survey, 3rd Ann. Rept.*, 1883, pp. 291–402.

posed of a number of individual discontinuous upland areas, whose tops stand at from 2000 to nearly 3000 feet. The central lowland is a great peneplane developed on weak folded limestone, most of which stands between 100 and 500 feet above the sea, monotonous for the most part but broken here and there by great unreduced residual masses, "slieves," that rise sharply above it to heights of several hundred feet, great bastions visible from long distances.

All of the northern upland, nearly all of the central lowland, and a little of the southern upland were glaciated during the régime of the last ice sheet.[7] Continuous glaciation reached its southern limit along a highly irregular line (Fig. 1) trending from the mouth of the Shannon on the Atlantic to Wexford on St. George's Channel. The ice that covered central and western Ireland had its source in two indigenous centers of dispersal, one in the highlands of Leitrim, Sligo, and Connaught, and one in the highlands of Donegal. The ice that covered eastern Ireland came over the floor of the Irish Sea from Scotland.[8] These relations, together with a group of highland centers of local cirque-making glaciation south of the limit of the last ice sheet, are indicated on the map (Fig. 1). Several restricted highland areas in central Ireland that carried local cirque-making glaciers after they were uncovered by the continuous ice sheet are not shown. At the climax of glaciation the two great centers of dispersal are regarded as having been entirely buried beneath the accumulating ice.

Many of the small cirque-making glaciers that proceeded from local highlands above or south of the continuous ice sheet have left diminutive looped end moraines of ridged till as additional records of their former existence. No end moraines of till, however, were made by the ice sheet itself. The southern edge of the last ice sheet came to rest against the northern face of the southern upland, which, except at four points where it is cut through by streams flowing southward, presents a face that sloped against the advance of the ice. The deposits formed at the edge of the ice, on the flanks of the upland masses, consist of stratified sand and gravel, strongly suggesting deposition in lakes caught between the ice and the upland.

The late-glacial deposits of the central lowland consist of a nearly continuous veneer of till (boulder clay) of variable thickness, and, lying above the till with very irregular distribution, the "eskers."

Description of the "Eskers"

The "eskers" resemble one another only in their irregularity. No two forms are exactly alike, but certain features are common to

[7] The time of the "Newer Drift" of British geologists.

[8] The Scottish ice may have reached as far west as the west coast of Ireland at some time before the last stage of the last glaciation. A. R. Dwerryhouse: The Glaciation of North-Eastern Ireland, *Quart. Journ. Geol. Soc. of London*, Vol. 79, 1923, pp. 352–422.

all. Three general types, classified according to surface form, may be recognized: elongate ridges, isolated mounds and hummocks, and broad flat-topped masses.

The elongate ridges are commonly miles in length. Some are simple; others are compound, consisting of two or three subparallel embankments connected by minor transverse ridges (Fig. 2). Some single forms have widths of several hundred feet; others are very narrow, with tops gently arched in cross profile. The tops of some are horizontal in longitudinal profile; others are undulatory even to the development of sharp knobs (Fig. 5). The tops of many are pitted here and there with kettles. Although the sides of some are smooth, many are marked by sharp projections and reëntrants.

The isolated mounds and hummocks occur in linear groups; again they are scattered about with no definite pattern. The tops of the members of any one group, however, ordinarily approximate a common level. The tops and slopes show all the variations that are characteristic of the linear forms.

The broad masses are flat-topped and mesa-like; they are irregular in plan and are of all sizes. One may have a surface area of scarcely an acre; another may cover a square mile or more. The tops are flat or very gently undulatory and are pitted here and there with kettles, some of them very large. The margins, like those of the other types, are smooth in some places and broken by projections and reëntrants in others. Some are directly connected with the ridged types.

The heights of all these forms, regardless of their shape in ground plan, range from about 30 feet up to nearly 100 feet above the ground on which they rest, so that the higher "eskers" are visible for miles across the bogs and plains that separate them. Again, all the forms are alike in respect to their sides. Their slopes form angles of from 25 to 35 degrees and thus lie at or near the angle of rest for the material of which they are composed.

Viewed in detail, the "eskers" present a pattern of seemingly hopeless confusion, since they occur without dominant orientation in the broad shallow valleys, on the low, poorly drained divides, and in every conceivable topographic situation. But when they are viewed in the large on a small-scale relief map their minor irregularities become inconspicuous, and definite trends stand out. Unfortunately, many of the broader mesa-like forms are not indicated on the detailed maps of the glacial deposits made by the Geological Survey, so that the general map of the "eskers" drawn on a reduced scale by Sollas tells only a part of the truth (Fig. 9). Yet, in spite of its incompleteness, the Sollas map shows that the groups and chains of "eskers" commonly follow the divides between the valleys and the upper slopes of the valley sides themselves. True, certain forms cross streams and at the crossings are broken only by narrow gaps through

which the streams pass; but these trends are laid out in sympathy with more important drainage lines, compared with which the crossing of a single stream is insignificant.

In some places two or more chains intersect; in others parallel chains seem to be entirely independent of each other. Some of the narrow ridgelike individuals visibly "climb"; that is they follow

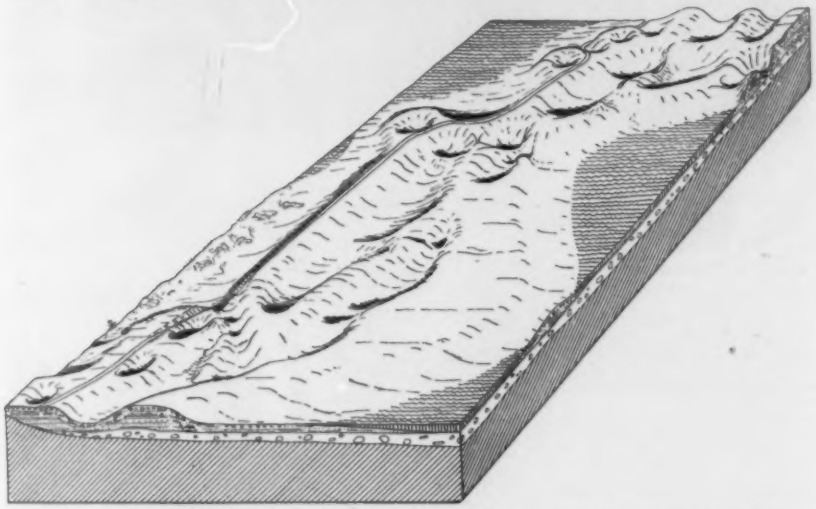


FIG. 2—Block diagram of part of an "esker" south of Clonmacnoise, King's County. The compound character of the ridges, the kettles, the relation of stratification to surface forms, and the flanking bogs (shaded areas) are indicated. Front of block about 2000 feet wide. (Drawn from photographs and field sketches. See Fig. 5.)

uneven paths, the elevation of their crests changing in response to changes in the elevation of the ground on which they were built. They stick to very gentle slopes, however, eschewing steep grades.

The "eskers" are built of sand and gravel, with the addition of boulders in some places and of laminated silt and clay in others. All of the sediments consist of fragments of the underlying bed rock, which, over the greater part of the lowland, is limestone. The individual pebbles and grains of sand are usually rounded as by streams, but a sharp eye can see that the rounding has only partly altered former faceted shapes; manifestly, therefore, the pebbles, before their deposition in the "eskers," had been derived from the ice-worn grist.

Invariably the bulk of the finer material is stratified; not uncommonly the coarsest material (the boulders and coarse gravel) is poorly sorted or not sorted at all, but even the unsorted material is washed, showing that it accumulated in water and was not, like the boulder clay, built on dry ground. Various types of stratification are exhibited in the numerous cuts and pits that have been made in the "eskers." Some exposures show the irregular lenticular stratification and cross-bedding characteristic of streams; others reveal perfect horizontality

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Typical landscape of the central lowland of Ireland. View west of Tullamore, King's County.

FIG. 4—The "Seven Churches" on the Shannon below Athlone. View from the churchyard, built on an elongate "esker," northwestward across the Shannon, with other "eskers" rising on the horizon.

FIG. 5—View of the elongate compound "esker" south of Clonmacnoise, King's County, shown in Figure 2. Detailed axial view showing irregular hummocky ridges inclosing undrained depressions.

FIG. 6

FIG. 7

FIG. 8

FIG. 6—Flat-topped mesa-like mass built of stratified sand and gravel, with ice-contact faces. Near Ballinasloe, County Galway.

FIG. 7—Level surface of a broad flat-topped mass of gravel pitted with shallow kettles. Ballydangan, County Roscommon.

FIG. 8—Spillway that controlled a late-glacial lake. Montpellier Gap, a long channel, now dry, at an elevation of 1050 feet, cut across a northern spur of the Wicklow Mountains south of Dublin.

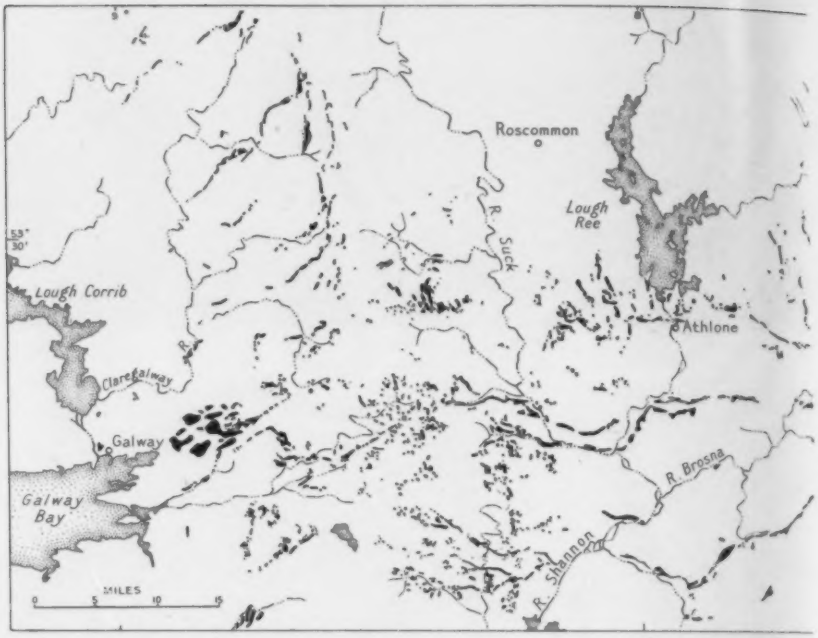


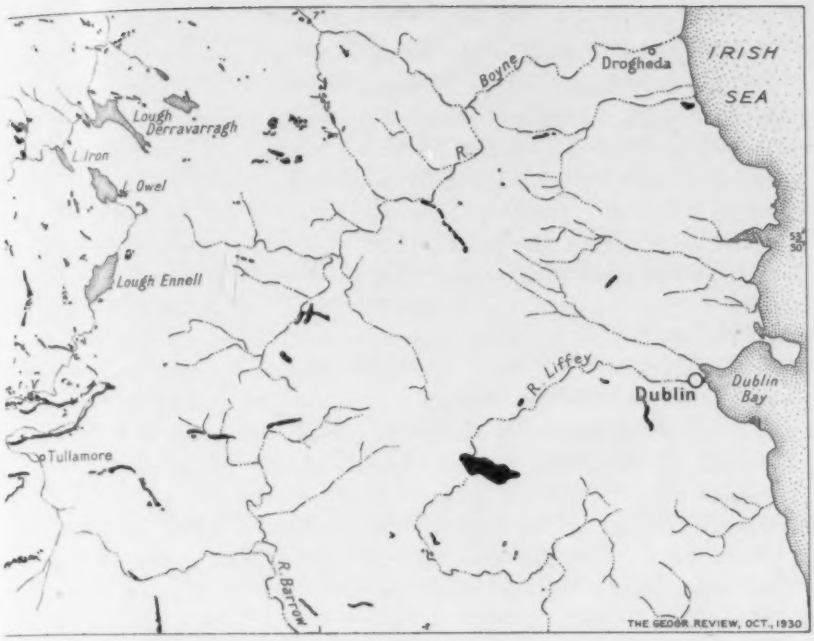
FIG. 9—Map of a part of the central lowland, showing some of the "eskers."

of stratification, with delicate laminations in silts and clays and ripple marks in fine sand (Sollas). In some sections the strata lie delta-fashion, with great foreset beds overlain by horizontal topsets. All of these exposures indicate deposition in water, here shallow and there deep, quiet in this place and agitated by strong currents in that.

Two other characteristics are significant. The first is that some of the "eskers" have cores or nuclei of bed rock, around which they were built. These cores were noticed as early as the middle of the nineteenth century, and a number of the detailed areal descriptions published by the Geological Survey after that time carry references to them. The second characteristic is common to every exposure in "esker" material and consists in the fact that the stratification near the edges of the forms is rudely parallel to the steep side slopes. This curious behavior of the layers of sediment was caused in part by slump after deposition in more nearly horizontal positions but in larger part by undisturbed initial deposition at angles oblique to the bedding planes in the center of the mass.

THEORY OF ACCUMULATION ALONG SUBGLACIAL STREAMS

From this brief description of the Irish "eskers" we proceed to an analysis of the theories advanced as to their origin.



Most of the elongate forms, but only a few of the isolated mounds and broad mesa-like areas, are indicated.

As the first modern investigator of the Irish "eskers," Sollas effectively disposed of the marine bar and beach hypothesis that formerly had been widely held. He contended that the "eskers" were the casts of subglacial streams.[9] He showed that their side slopes are definitely not erosional but represent instead the limits of initial accumulation of the stratified material. He pointed to the steep angle formed by the side slopes and to the slumping evident in exposed sections and contended that the accumulating sediments must have been held up by walls that later vanished and that such walls could only have been walls of ice. He held that the stratified and commonly cross-bedded character of the sands and gravels indicated fluviatile conditions of deposition. Finally he maintained that the branching pattern made by the groups and chains of deposits was, except for its discontinuity, essentially a stream pattern.

Although much of Sollas' theory appears, in the light of later knowledge, to be entirely sound, it fails to consider the broad mesa-like masses which are fully as numerous and widespread as the narrow ridges. Many of these are far too wide to have been developed in tunnels, and their shapes do not remotely resemble the shapes of former streams.

[9] When Sollas evolved this conception, he did not know that the origin of similar forms had been explained in the same way by Hummel (1874).

Theory of Submarine Accumulation

In an admirably lucid paper written nearly a quarter century later, J. W. Gregory[10] held that the majority of the Irish "eskers" were laid down in the sea, freely and without confining glacier walls, along the retreating-and-halting margin of an ice sheet. This mode of origin is identical with that assigned by Sederholm[11] to the great Salpausselkä of Finland. Gregory argued that most of the "eskers" are oriented transversely to the direction of ice movement indicated by striae and the axes of drumlins and therefore must be more or less parallel to the trend of the former ice front. Most of the forms lie at elevations between 100 feet and 350 feet above present sea level. This restricted vertical range indicates that accumulation was controlled by some agent widespread horizontally but limited vertically, such as a sheet of water, in which the glacial detritus was heaped into subparallel ridges during successive halts of an ice front, separated by periods of retreat. Such a sheet of water was probably the sea, since no visible means existed by which a lake could have been held up at its southern end to the required level, and since fragments of marine shells occur in the boulder clay and stratified drift, and occasional pebbles taken from "eskers" carry calcareous incrustations that are thought to have a marine organic origin.

Gregory considered that the ridges that are not normal to the inferred direction of ice movement were formed successively from south to north at the receding points where glacial streams entered the sea, thus following De Geer's explanation[12] of the Swedish *åsar* and Hershey's explanation[13] of certain American forms. The numerous groups of individual isolated mounds and hillocks were still to be accounted for, and Gregory explained these as erosion remnants left after partial dissection of continuous sheets of sand and gravel by postglacial processes. There yet remained the considerable number of forms that stand at elevations higher than 350 feet—too high, therefore, for deposition in the postulated sea. These Gregory explained as deposits washed in by streams along the margins of glaciers descending valleys from local ice centers.

Gregory pointed to a weak spot in Sollas' theory in that he showed the impossibility of assigning a fluviatile origin to the fine sediment and horizontal lamination visible in many exposures and ably contended that such material, so stratified, points only to deposition in standing water. On the other hand, there exist in Gregory's theory

[10] J. W. Gregory: The Irish Eskers, *Philos. Trans. Royal Soc. of London*, Ser. B., Vol. 210, 1920, pp. 115–151.

[11] J. J. Sederholm: Esquisse hypsométrique de la Finlande, *Bull. Commission Geol. de Finlande*, No. 9, 1899.

[12] Gerard De Geer: Om rullstensåsarnas bildningssätt, *Geol. Foren. Förhandl.*, Stockholm, Vol. 19, 1897, pp. 366–388.

[13] O. H. Hershey: Eskers Indicating Stages of Glacial Recession in the Kansan Epoch in Northern Illinois, *Amer. Geol.*, Vol. 19, 1897, pp. 197–209 and 237–253.

certain elements of inconsistency and certain other elements that do not agree with the facts. For example, the statement that most of the "eskers" are oriented transversely to the direction of ice movement is true only in the most general way; even on such a map as that of Sollas the exceptions are nearly as numerous as the agreements. Approximate parallelism with the trends of the modern valleys, which are cut into the surface of the limestone, is much more apparent; yet this factor is not considered. Furthermore, the statement refers only to the elongate chains and fails to take into account the broad masses that are almost equally numerous.

The argument that the water involved was marine has several vulnerable points. The conception of a rise of the sea through 350 feet above its present level (to say nothing of the rise required above its diminished late-glacial level) while ice still covered much of Britain, is based on little internal evidence, is wholly without external evidence, and is therefore little more than an assumption. It has long been known that shelly drift was incorporated in the Scottish ice during its advance over the floor of the Irish Sea and that it spread over wide areas in Ireland up to heights as great as 1300 feet. Since the "eskers" are composed of rearranged boulder clay, the occurrence in them of fragments of marine shells is to be expected. Again, the established existence of extensive deposits made in spillway-controlled glacial lakes at various elevations throughout the entire vertical range of the "eskers" is fatal to a marine theory. Finally, the conception of a sea standing over the central lowland at 350 feet above its present level makes necessary four wholly different explanations for forms that are entirely similar: as marginal marine deposits, as marginal fluvial deposits, as subglacial-fluvial deposits, and as erosion remnants.

Theory of Marginal Subaerial Accumulation

Charlesworth[14] rejected Gregory's marine theory, clearly showing that the presence of abandoned spillways associated with ponded water deposits around the highland areas is incompatible with such a conception. He constructed a generalized field map of the stratified glacial deposits of central and southern Ireland, adding to the linear "eskers" of Sollas' map many of the broad pitted areas that consist of groups of hummocks approaching a common level. He recognized that these broad areas must share a common origin with the linear forms.

Charlesworth, however, retained certain features of Gregory's postulate. He believed that the majority of the "eskers" were mar-

[14] J. K. Charlesworth: The Glacial Retreat from Central and Southern Ireland, *Quart. Journ. Geol. Soc. of London*, Vol. 84, 1928, pp. 293–344.

ginal deposits laid down along the successive positions of a retreating-and-halting ice front not in the sea but on dry land. Like Gregory, he assigned an *ås*-origin to the linear forms that manifestly do not trend in a direction normal to the movement of the ice.

Charlesworth's explanation did away with the necessity that compelled Gregory to assign four different origins to various groups of "eskers," by requiring only two origins—the marginal subaerial deposit and the *ås*. But Charlesworth based his differentiation on orientation alone, leaving form, composition, and stratification entirely out of consideration. His conception, however, is even more vulnerable in that it was based on surface form alone. "I have deliberately refrained," he says (p. 333), "from presenting any argument based upon the composition and structure of the accumulations, partly as this has already been done by Prof. J. W. Gregory, and partly because of its unconvincing nature, preferring to rest the final and, as it appears to me, decisive verdict upon the course of the morainic tracks which are not open to different and conflicting interpretations."

It is true that arguments based on composition and structure (i. e. *stratification*) were advanced by Gregory; but, as their author ably showed, they pointed one way and one way only—to deposition in ponded water. Any argument that aims to prove deposition on dry land must first dispose of this apparently insuperable obstacle instead of merely ignoring it. With regard to the "course of the morainic tracks" on which Charlesworth's theory leans so heavily, the generalized map (Pls. 23, 24) that accompanies its exposition imparts to the "eskers" a looped or festooned trend in ground plan which most geologists who have seen these forms unite in agreeing they do not possess.

The "eskers" are built of stratified sand and gravel. If deposited marginally on land they must have been laid down by streams debouching from the ice. Their form must then be that of compound outwash fans or plains, each with a steep north slope that was formerly banked against ice and a gentle south slope with a profile gently concave upward. The water that escaped from the ice at any stage of halt must here and there have cut through the deposits formed during previous halts, eroding definite channels across them. But the "eskers" do not satisfy these requirements. Their south faces are identical with their north faces, standing as hummocky slopes at angles of 25 to 35 degrees; and the faces on the west are identical with those on the east. Whatever controlled the formation of one face controlled the formation of them all. Furthermore, as Sollas proved, none of the "eskers" has been subjected to erosion. They stand upon the surface of the lowland in their initial state. No streams have undercut them, and no gullies have dissected their edges. The

conception that these forms were built at an ice front which then receded northward without discharging meltwater past them is wholly untenable.

The Marginal Lakes and Spillways

Charlesworth made a further valuable contribution by calling attention in three papers[15] to the significant series of ice-dammed lakes and controlling spillways that characterize the flanks of the mountain masses.

The flanks of the mountain masses against which the ice rested, such as the Wicklow Mountains, Slieve Ardagh, and Slievenamuck, as well as the isolated masses within the glaciated area, such as the Keeper Hills, Slieve Aughty, and Slieve Bloom, are characterized by flat-topped pitted terraces of sand and gravel that were built up in temporary lakes caught in reëntrants between the mountain slopes and the surrounding ice. The levels of these lakes were controlled by overflow channels or spillways (Fig. 8) cut into the bed rock, usually across spurs that separate the mountain valleys. The terraces occur in descending flights of steps, each step leading into its own spillway. It is evident that the former lakes existed successively, a higher lake disappearing as soon as the shrinking ice uncovered a potential spillway at a lower level. The elevations of these remarkable terraces and channels, which have been described in detail by Charlesworth, range from 1215 feet down to about 50 feet above present sea level. "The Curragh" near Kildare is a great pitted sandy plain of this type. The terraces at Howth Head near Dublin, nestling in a reëntrant above the very sea cliffs, have a similar origin in that they were trapped in a lake held against the land by the ice off what is now the shore.[16] Much more extensive pitted terraces face the sea along the greater part of the Dublin-Drogheda-Dundalk coast. Again, lacustrine deposits occupy the valley of the Lagan at and above Belfast. Pitted terrace complexes are strongly developed on the coast near Ballycastle, facing the sea at the northeast end of the Antrim Plateau.

Other identical features are common throughout the northern upland; the total number described and indicated on published maps runs to many score. The significant point they furnish to the present discussion is that they record many successive temporary stands of ponded water, not only at the edge of the ice sheet but around nunataks that projected through it.

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[15] Charlesworth, *op. cit.*; *idem:* The Glacial Geology of the North-West of Ireland, *Proc. Royal Irish Acad.*, Vol. 36, 1924, Section B, pp. 174–314; *idem:* The Glacial Geology of North Mayo and West Sligo, *ibid.*, Vol. 38, 1928, Section B, pp. 100–115. See also Dwerryhouse, *op. cit.*

[16] H. J. Seymour: in "The Geology of the Country Around Dublin," *Geol. Survey of Ireland, Sheet Memoir 112*, 1903, pp. 80–82.

Conclusion

An examination of the valid points made by those investigators who have published their observations and ideas on the Irish "eskers" brings clearly forth a series of facts that any rational account of the origin of these curious forms must fully explain:

1. The "eskers" consist of masses of (commonly horizontally) stratified sediment, the masses varying in shape from broad flat-topped and pitted masses to narrow ridges.
2. This material was deposited chiefly in ponded water but in water ponded at various levels; some of the material, however, is fluviatile.
3. All the sides of every form were without exception retained by walls of ice that melted back slightly throughout the period of accumulation, causing slumping and overbuilding of the beds of the growing mass.
4. No erosion of the accumulated sediment took place after the building process ceased.

This very definite combination of facts can be explained in one way only. The requisite conditions are fulfilled by a great mass of *stagnant* ice standing over the whole of the central lowland, its entire expanse seamed with crevasses and tunnels, the former filled with standing water, and some of the latter furnishing conduits through which flowing water connected the crevasses. The ice must have been stagnant, since the slightest movement of the mass would have disturbed or destroyed the delicate system of detrital deposits accumulating within and beneath it. The ice must have melted away in place, because any withdrawal of an ice front would have discharged streams of meltwater, trimming and characteristically scarring the weak gravel slopes. The southern edge of the ice, facing an adverse slope, formed the marginal lakes described above; and, as melting progressed, other lakes developed around the major nunataks. These lakes, ponded in local reëntrants and controlled by lateral spillways leading across spurs, were not local but extended back northward through an intricate network of crevasses and subglacial tubes with hydrostatic interconnection, so that any one spillway governed not only the water at the ice margin but a huge area of ice canals and ice tubes reaching far to the north.

Some of the canals were widened at favorable points into broad lakes, in which were deposited the great mesa-like masses of detritus. Where marginal shrinkage of the ice caused the abandonment of a spillway in favor of a channel at a lower level, the level of the whole hydrostatic system dropped in sympathy, some tunnels were aban-

doned before they became crevasses, and some of the crevasses that rested on higher ground were drained dry. As the spillways played their successive rôles in descending order, the detrital fillings of the cracks and crevasses were successively abandoned by their parent lakes, and all the while the subglacial streams descending from higher ground deserted their choked-up channels for other more open courses continually furnished them by the melting of the ice, thus leaving local groups of winding ridges of fluviatile deposits with patterns like the patterns of modern streams.

With accurate maps and precise leveling, the agreement in elevation between the flat-topped terraces of the marginal lakes and the flat-topped intraglacial deposits could be readily demonstrated. The lakes were probably fed by subglacial streams and by the water from surface melting that dropped directly into them. The surface of the ice melted steadily downward, interrupted by ice-free areas of ever increasing width, until the last remnants lingered in the valleys and in the greater depressions in the boulder-clay ground moraine, which in the postglacial epoch became lakes and bogs. Several writers have pointed out the fact that over the lowland the "eskers" tend to follow the low divides between the lakes and bogs. The sequence of events outlined above is entirely in agreement with this distribution, since the crevasses would form on the higher ground surrounding the blocks of ice that rested in the hollows.

The inevitable conclusion, then, is that the Irish "eskers" are the great casts of a system of lake-filled and stream-filled cracks that seamed a decaying ice field. Cracks are inherent in any glacier through the starts and strains attendant on motion. Its motion once lost, the ice could not close them up; and they must remain as lines and planes of weakness. The rock nuclei or cores observed in some of the "eskers" are significant in this connection since any boss or ridge of bed rock is likely to form a crevasse in an overlying mass of stagnant ice.[17] That the ice over the central lowland stagnated before it melted away must have occurred to Sollas, for he spoke of it (p. 793) as "melting away and becoming stationary"; and of the crevasses he said "they must be in union with one another and with the free margin of the ice. . . . " Later in his argument he is more specific. He speaks of the absence of indications of pronounced glacial erosion over the central lowland and adds (p. 821) that "the movement of the ice in the centre of the country was sluggish; it probably accumulated here in an immense pool, and possibly persisted as a *piedmont* glacier up to the closing stages of the Glacial Period." It is far from difficult to imagine that ice proceeding from local centers and moving vigorously down the steep slopes of the northern upland should find its rate of movement checked as it crept

[17] R. F. Flint: The Glacial Geology of Connecticut, *Connecticut Geol. Survey Bull.* 47, 1930, p. 82.

southward across the broad monotonous plain with no gradient to help it. Any decrease in the feeding of ice from the uplands over which it originated, following even a slight climatic amelioration, very possibly would have been sufficient to choke from the enormously expanded bulb of lowland ice what little movement was left to it.

The occurrence of a similar stagnation of the last ice sheet in northeastern North America, over an area much greater than that of central Ireland, has been discussed by the writer.[18] The phenomenon is by no means unique. It is, however, picturesque; and under the impetus of compelling evidence we must employ it as the only possible explanation of the Irish "eskers."

[18] *Idem:* The Stagnation and Dissipation of the Last Ice Sheet, *Geogr. Rev.*, Vol. 19, 1929, pp. 256–289.

THE GUANO ISLANDS OF SOUTHWESTERN AFRICA

Arthur C. Watson

AMONG the far-scattered regions visited by the American whalers and sealers was the desert coast of southwestern Africa. To one narrator Possession Island, off Elizabeth Bay, appeared thus:

> The Island presents a most forbidding and repulsive aspect, one at which the mind recoils with horror; it appeared as though it had never been made for the use or benefit of either man or brute, but had sprung into existence through some of natures wild freaks, the vomiting of some subterranean fire. . . . Possession is the name of it, and the rightful proprietor we presume is the Simoon of Africa, as its dry, arid surface too plainly indicates. Seal, however, have been taken here in great numbers, to judge by the quantity of bones strewed upon its barren surface; and, although they showed instinct in selecting this void in creation as one of their numerous haunts, yet man . . . has followed and swept them from the island.[1]

"A region wind-swept, barren, and desolate beyond description," says a recent description of the Namib, the Hottentot name by which the desert coast of South West Africa is generally known.[2] For the most part it is a dreary line of sand hills, monotonous and without vegetation. At intervals along the coast are the "bird islands," small masses of rock to which sea birds resort in vast numbers. Chief among these islands are Hollams Bird Island, Mercury, Ichabo, a few islets in Angra Pequena Bay, and Possession.[3] Here in season come the seals, covering the rocky shores and reefs.

The region is practically rainless, though a thick haze frequently clings to the horizon; and at night dews are heavy, the air is chilly, and thick fogs prevail. The winds are treacherous.

Early History of the Islands

The abundance of whales along the coast and the large number of seals on the islands attracted Yankee vessels at an early date. The whaling grounds off Guinea were opened about 1763, and from there the more enterprising captains worked their way south. In the year

[1] From the private journal of Washington Fosdick, who was either ship's steward or cook of the schooner *Emeline*, of Mystic, on her voyage of 1843–1844. This journal is now in the collection of the New Bedford Whaling Museum.

[2] P. A. Wagner: The Geology and Mineral Industry of South-West Africa, *Geol. Survey of Union of South Africa Memoir No. 7*, Pretoria, 1916. The most complete description of the region is to be found in Erich Kaiser: Die Diamantenwüste Südwest-Afrikas, Berlin, 1926.

[3] Cf. Africa Pilot, Vol. 1, *U. S. Hydrogr. Office Publ. No. 105*, 1916.

FIG. 1—Reproduction in black and white on a slightly reduced scale of a portion of the map of South West Africa 1 : 500,000 (South G-33, 1927) showing Ichabo (Itshabo) and other guano islands.

1773 fourteen American vessels returned from the African coast, and, when American whaling revived after the gloom of the Revolution, a large proportion of the vessels visited these waters, particularly from the parallel of 16° S. to the Cape of Good Hope. "Woolwich" (Walvis) Bay appears often in the late eighteenth-century records. Some of these voyages were strictly for whales, others for fur seals, and others were "mixed." On his voyage of 1828 Captain Benjamin Morrell, Jr., obtained several thousand skins at Ichabo and Mercury and incidentally tells of seeing the results of a plague of seals off Angra Point and Possession Island.[4] He found thousands of carcasses, appearing as though the animals had all died at about the same time.

The experiences of Captain Gurdon L. Allyn recorded in his memoirs were undoubtedly typical of many sealmen of his day. In January, 1830, he arrived off Ichabo Island on the schooner *Spark*, of New London,

> too late for this season, for an examination of the shore revealed about a thousand carcasses of seal which had been deprived of their skins by those who had arrived there on a similar errand to ours. . . . The coast was well sealed and we could only glean a few from the roughest rocks.
>
> Six days passed and our consort, the Putnam [the schooner *General Putnam*, of

[4] Captain Benjamin Morrell, Jr.: A Narrative of Four Voyages, New York, 1832, p. 291.

Newburyport], arrived; and as we were likely to fall short of water . . . we put our water-casks and our mate on board of her and despatched her south to Saldana Bay [500 miles to the south], while her captain came on board of our vessel and proceeded with us to seal along the coast.

We found a few seal at each landing.[5]

Captain Allyn remained on the coast through the fall season and returned home in the spring of 1831. Early in the fall of 1834, in command of the schooner *Betsey*, of New London, he was again on the coast. He found the seals scarce and shy and with difficulty managed to secure about 800. The *Betsey* spent two more seasons on the coast, most of the time in company with the brig *Tampico*, of Mystic. Luck was again poor, and the market for furs had declined. The voyages of the *Betsey* and the *Tampico* were presumably the last sealing operations on the West African coast for many years. But a new commodity gave to the coast greater prominence than it possessed even during the height of the seal fishing. Great was the astonishment of Captain Allyn when, on a brief visit to Ichabo in command of the schooner *Franklin*, of New London, in August, 1843, he found "planks, wheelbarrows, pickaxes, and bags of guano, apparently left without ceremony."

The Guano Deposits and Their Origin

Guano, the first commercial fertilizer used in any large quantity, is not a bird manure, but a new substance formed by its decomposition under extremely dry climatic conditions. Its formation requires the presence of a multitude of certain species of birds perennially nesting and raising another multitude within a comparatively small area. And, as the guano birds are fish eaters, their presence depends upon a proportionate abundance of small fish within easy range. The most famous guano deposits are those of the islands off the coast of Peru, washed by the cold Humboldt Current.[6] Similarly the cold Benguela Current of the southwest African coast presents conditions favorable to guano-producing birds. Here the chief species are *duikers* and *malgash*. The *malgash* congregate for their breeding season from October to April or May, and the *duikers* from December to June. The islands differ in their bird life; and on the Island of Ichabo, whose guano had the reputation of being the best on the coast, the *malgash* are in exclusive control except for the jackass penguins, which play a minor part in the production of guano.

Ichabo, as the English interpreted the Hottentot name, was the first island from which guano was taken. It is situated 1400 yards from the mainland and is about 600 yards long by 200 yards wide.

[5] Captain Gurdon L. Allyn: The Old Sailor's Story, Norwich, Conn., 1879, pp. 30–32.

[6] See Robert Cushman Murphy: Bird Islands of Peru, New York and London, 1925; and *idem:* Oceanic and Climatic Phenomena along the West Coast of South America during 1925, *Geogr. Rev.*, Vol. 16, 1926, pp. 26–54.

Estimates of its height before the removal of the guano vary considerably, but it seems certain that at some points the deposit was at least sixty feet deep, resting on a granitic foundation about thirty feet above sea level. The first shipmaster who visited Ichabo for the purpose of procuring guano estimated the deposit to consist of between 700,000 and 800,000 tons.

The first diggings at Ichabo were done perpendicularly by pickaxe crews working from stagings. Consequently, the distances below the surface of objects buried in the guano were easily ascertained. Sealskins found at a depth of twenty to thirty feet were fairly well preserved when uncovered but rotted quickly when exposed to the air. During the height of the Ichabo boom a coffin containing a fairly well preserved body was excavated. The inscription on the lid of the coffin indicated that the body was that of a Dutchman who had died in 1689. If so, the guano had risen twelve or thirteen feet in 155 years, since the coffin was found eighteen feet below the surface.

The Beginning of the Boom

Long before the Spanish Conquest the Incas of Peru had discovered the value of guano. The first suggestion that Old World soils could be enriched by guano came through Garcilaso de la Vega in his "Royal Commentaries of the Incas"; but his suggestions met with no response until the beginning of the nineteenth century, when Alexander Humboldt made an intensive study of guano, bringing home with him the first specimens to arrive in Europe. In 1835 the first consignment of Peruvian guano was imported into England. In 1840 twenty casks were received, and experiments made on wheat and turnip crops proved so successful that a definite interest was at last aroused. In the following year seven vessels brought 1733 tons to England from the Chincha Islands; and in 1842 forty-one British and three foreign vessels landed a total of 13,094 tons.[7] The next year, however, saw a decline apparently due to the action of the Peruvian Government in leasing the guano rights to a single British firm.

The monopoly situation thus created by the Peruvian Government stimulated efforts already in progress to find new sources of guano. In the quest Captain Morrell's book played an interesting part. A single sentence was devoted to the observation that the bird deposits on the Island of Ichabo appeared to be twenty-five feet thick. This was brought to the attention of John Rae, an enterprising merchant who had become interested in the commercial possibilities of guano. With great secrecy a fleet of at least three vessels was sent out to find the island. Only one of them, the brig *Ann*, remained to carry out a thorough search; and even her master, Captain Parr, was ready to

[7] Cf. Statistics of Guano, *Journ. Amer. Geogr. and Statist. Soc.*, Vol. 1, 1859, pp. 181–189.

admit failure, when, sailing to Cape Town to take on supplies for the homeward passage, he had the extraordinary luck to meet an American whaling captain who had visited Ichabo and could provide the necessary sailing directions.

It was evidence of the *Ann's* visit that had surprised Captain Allyn in August, 1843. She had taken on three-quarters of a load of guano when a gale forced her to sea. She did not return to complete her cargo but sailed home, arriving at Bristol in July, 1843. Captain Parr was then prevailed upon to accompany a large fleet assembled by firms of Liverpool and Glasgow. Secrecy again attended the departure, the ships leaving under sealed orders. The first vessel to arrive at Ichabo was the bark *Douglas*, whose captain immediately took possession of the island for the Queen. Although the British Government did not claim possession until many years later (1861),[8] the British flag was permitted to fly over the island, and ships of other nationalities had to endure many disagreeable experiences on account of this unofficial claim.

Then began the flood of African guano into Great Britain. Early comers at Ichabo staked out claims like conquerors on a new continent. Each claim was called a pit, and the boundary lines extended back from the eastern shore. Stagings were needed for the digging, and each pit was furnished with a raft or wharf which extended out over the rocks. Along these structures men transported guano in wheelbarrows or carried it in bagfuls on their backs. Most claims were held by merchant companies, and vessels belonging to privileged firms found pits awaiting them; other vessels were forced to wait weeks and had to accept the price demanded by the claim-holders.

The "Emeline's" Adventure

The first American vessel to participate was the square topsail schooner *Emeline*, of Mystic[9]. The *Emeline* had spent the season of 1843–1844 in sea-elephant hunting at the Crozets. On her return a bad leak developed, and she put into Cape Town in distress. Here she followed the advice of the American consul, Isaac Chase, ardently interested in the promotion of his country's trade. Consul Chase

> deemed it the wisest plan for all interested that we dispose of our cargo and then proceed along the coast to take a load of guano or bird manure, which is in high repute and equally valuable as oil. We would then proceed to the Indies, there dispose of the guano and take in a cargo on freight or proceed homeward in ballast. . . . We were informed that there were plenty of seal on the coast and that the consul wished us to go prepared to take them; it would be of no hindrance to us as they were in the vicinity of where guano would be procured. Also we learned that our ballast would be water, which would sell readily for five pounds the ton to shipping there.

[8] G. M. Theal: History of South Africa from 1795 to 1872 (3 vols., London, 1915–16), Vol. 2, p. 236.

[9] See footnote 1.

Sailing orders were given by the consul under seal, to be opened as the vessel was leaving Table Bay.

This secrecy is no doubt for our own good that we may reap the benefits of a chance now open and known only to the consul. We are also informed here that so great is the demand for guano that the packets are taking it from England to the United States. This much we do know: vessels fit out from the Cape especially for it, return, and then reship it to Europe.

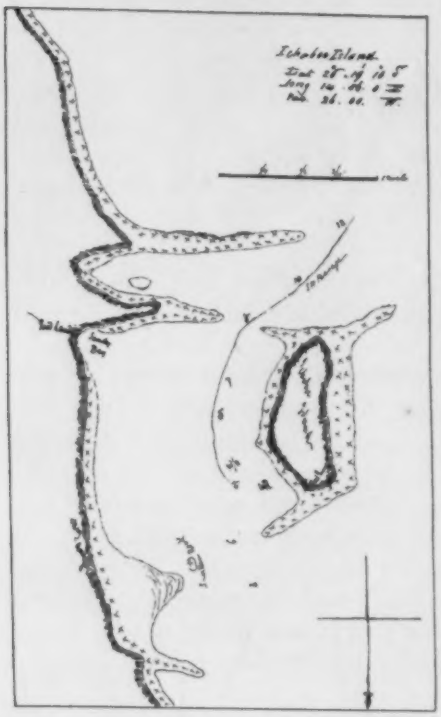

FIG. 2—Reproduction on a reduced scale of the sketch chart sent to the United States Department of State by Isaac Chase, consul at Cape Town, with his dispatch of July 30, 1844. (Courtesy of the Department of State.)

On March 28 the *Emeline* had reached the guano coast and was lying at anchor under the lee of Possession Island.

After dinner the captain went on shore and examined the state of the island as to our cargo of guano. The result of his examination was that the article was not of the quality that we wished.

At 5 a. m. we were fairly under way, with light breezes from the southward, coasting along to Angra Pequena. . . . In this bay are located three islands, called Shark, Penguin, and Seal islands.

At 1 p. m. we came to anchor under the lee of Seal Island. After dinner we went on shore and visited the island and found it to be a barren rock formed principally of quartz and feldspar. In traversing the island we observed several parties belonging to the vessels at anchorage in the bay busily engaged in obtaining guano.

This guano is obtained from chasms and fissures of the rocks, which have been filled partly by the periodic visits of the seal in pupping and shedding seasons and partly by being the rookeries of the sea fowl. These united have filled these chasms for centuries upon centuries back. . . . At some places it [guano] is found to the depth of thirty feet.

Friday, March 29th . . . At 12 Meridian the wind breezes up from the southwest; but, it being too late in the day for thinking of getting under way, a boat's crew went ashore [at Seal Island] after guano. At 3 p. m. the boat returned with a load consisting of 22 bags . . . During the afternoon two loads more came on board—in all 45 bags.

Saturday, March 30th . . . At 7 a. m. we were fairly under way, bound for Ichaboe. At Meridian rounded to under the lee of the island, passing through a fleet of shipping, thirty-three in number.

The shipping here are all English, our flag being the only American one. The island appears like a human hive, the busy throng hurrying to and fro on stages. The plying of boats back and forth forms quite an animated scene.

After dinner partial arrangements were made for the use of a stage in loading, at the price of 7 pounds 10 shillings, to be paid in water and vegetables. During the afternoon we threw overboard the guano obtained at Seal Island, as it is a very inferior article. In coasting up this morning we saw a great number of seal, two or three reefs or hammocks being covered with them. Presume that one or two thousand fur seal could be taken here in a very short space of time and without much difficulty.

Sunday, March 31st. Since we have been here 50 pounds has been offered us for the use of the schooner to proceed six degrees to the northward to see if there are any more islands near the main. The cruise would have taken about a week. At 2 p. m. sold ½ bag of potatoes for 10 shillings cash.

The guano here is of the purest kind and of the depth of 50 to 60 feet. On the lee side of the island are some twenty or thirty stages rigged out, made of spars and timbers, along which the guano is carried in bags and thrown in to their respective boats. The island is about a quarter to half a mile in circumference and is one solid hill of guano. It had been originally a large, or rather a number of reefs slightly elevated above the water . . . From the manner in which they are taking it away, in a year's time it will be reduced to its original size. At 8 p. m. calm and foggy.

Tuesday, April 2nd. Two more vessels arrived here this morning.

During the day the captain of a bark laying here, hearing of the enormous price charged by the agent for the use of a stage, kindly offered us the use of his, and also permission to dig beside him in his pit (which is the best on the island) as soon as the brig is loaded whose crew are now at work in his pit.

During the day a ship and a bark arrived here, and one ship sailed. Several more are nearly ready for sea.

Friday, April 5th. Begins with light airs from the southward. At daylight went on shore and active operations were commenced in the guano line. Both boats were constantly going . . . After dinner it breezes up quite fresh from the southward, so much that we can use only the large boat. In the course of the day we stowed away 264 bags. . . .

Monday, April 8th. Begins with light airs from the southward . . . All hands determined to take advantage of a fine day, and drive the work to the utmost of their power. We received three boatloads on board before any other single boat belonging to the fleet landed, and throughout the day it was one continued scene of bustle and activity . . . We received in the course of the day 19 boatloads, bringing in the aggregate 710 bags, the bags averaging about 100 pounds each, and making us now about 41 tons on board.

Tuesday, April 9th . . . Today two more vessels arrived, one of them a large Indiaman carrying 12 or 14 guns, with a complement of middies and marines. She is also after guano.

Wednesday, April 10th . . . During the day took in 375 bags, the balance of our cargo, and, in accordance with the general usage here, gave three hearty cheers when the last boat left. After her arrival alongside to unload, the last bag was suffered to remain until everything was in readiness, when we hoisted it up as far as the tackle would admit amid the cheering of the crew. This was responded to by most of the shipping in the harbor. We gave them Yankee Doodle on the flute, the Star-Spangled Banner unfolding itself at the same time to the breeze, the only one among the fleet.

Thursday, April 11th. Begins with light airs from the W. In the forenoon I went on shore for the first time and took a thorough view of the island. It is larger than I had any idea of, and two years will elapse before they can remove all the guano should they employ all the shipping now afloat. The different portions (or pits, as they style it), some a little further advanced than others, give the island the appearance of a huge fortress, with its ramparts and abutments. Each party as they work

are leaving the walls perpendicular, and so hard is the substance they are compelled not only to use the pick-axe but the beetle and wedge.

Saturday, April 13th. Begins with light airs from the northward and a very heavy fog. At sunrise the mists begin to disperse, and there is every prospect of soon getting under weigh. At ½ past 8 a. m. light airs from the southward. Immediately commenced heaving up and by ½ past 9 a. m. we were under full sail—homeward bound via the West Indies. A bark called the *Black Prince* sailed this morning in company with us.

Since we have been here we have been extremely fortunate, more so than any other vessel in the whole fleet. Vessels which arrived before us are still remaining there without having received a single bag of Guano on board; they have been compelled to put on board some other vessel some 1000 or 1500 bags to obtain the privilege of working in the pit, besides paying a heavy bonus of 30 to 45 pounds sterling for the use of the stage, and that to their own countrymen.

The *Emeline* arrived at Bridgeport, Barbados, on May 25 but, being an American vessel, was not allowed to land her cargo. She sailed to Martinique, anchoring at Fort Royal, and a sample of the guano was taken on shore. "The article is unknown here, as we are the first vessel which has ever brought any to this port." Having had no success at Martinique, the schooner proceeded to St. Thomas. Here "the captain went on shore and, from the conversation held with several planters, the supposition is that he will dispose of the cargo at St. Cruz. Freight is plentiful and vessels are in demand." A missing leaf in the journal leaves one in ignorance of what luck the *Emeline* had with her cargo at Santa Cruz. But the prospects sounded good, and it is reasonable to suppose that she followed the instructions of Consul Chase and disposed of her cargo before leaving the West Indies.

Ichabo in Its Glory

The journal of the *Emeline*, describing troubles incidental to the guano boom at Ichabo, merely suggests the riot and turmoil that followed. During the year 1844, the fleet at anchor kept steadily increasing. The roadstead was overcrowded, vessels were moored to each other, and many were forced to ride at anchor outside the roadstead proper. Questions of ownership and privileges were usually settled by the law of the fist. There were no distractions on the coast, and when men did let off steam they ran amuck. In May, 1844, a group of captains and some of their men, for want of better activity, went to the mainland and, rushing upon a temporary settlement of Hottentots, killed their dogs, plundered their huts of bows and arrows and of the ostrich shells in which water was kept, and fired the settlement. The other captains decided that the turbulence needed a controlling authority and dispatched a vessel to Cape Town with an appeal to the colonial government.

The warship *Thunderbolt* was sent to the island, and her captain appointed a committee of twelve ship captains, vesting in them full

authority in the name of the Queen. But peace ended with the departure of the *Thunderbolt*. By the first of July the fleet had increased to nearly 100 vessels, and the total number of men was estimated at 2000, a disorderly mob fighting for privileges on an islet less than a mile in circumference. The later arrivals, furious over a system which forced them to wait interminably and then pay exorbitant fees, broke out in mutiny.

The warship *Isis*, commanded by Sir John Marshall, arrived, and the authority of the committee was reëstablished. But the fleet still kept increasing, and there were constant murmurings against the high-handedness of the claim holders, whose régime was supported by the *Isis*. Their charge of £100 for the privilege of digging guano makes the earlier "£7 10s." system seem petty indeed. Finally the administration refused all island privileges to non-Britishers.

Up to this time American interest in the guano islands had been slight in spite of the efforts of Isaac Chase. On July 30, 1844, he wrote to the Secretary of State enclosing a chart of the island (Fig. 2). He gave details of the equipment needed by such ships and recommended that

> the best season of the year for lying at the island is October, November, December, January, February, March, April, and May. During the months of June, July, and August the northerly winds prevail causing the anchorage to be considered unsafe. The Island of Ichaboe lies outside the limits of the colony and . . . is claimed by no state or nation.

He succeeded in obtaining the abolishment of prohibitions on oils, salt beef, pork, and fish and suggested that American whalers might find it to their profit to sell their oil at the Cape and proceed to Ichabo for a cargo of guano, thus making a double profit.

Meanwhile Captain Allyn arrived at New London on April 8, 1844, with news of the profits that could be made in guano. He convinced his agents of the desirability of participating in the trade and on June 20 was off for Ichabo in command of the ship *Brookline*. When he arrived he found that the governing committee had resolved that no foreign vessels should be allowed to load until all English vessels were loaded. Complaint lodged with the consul had the desired effect, and on October 17 a government communication informed Mr. Chase that the *Thunderbolt* was carrying new orders to Ichabo and that "American ships resorting to the island for guano are to have the same privileges in all respects that the English vessels possess in reference to the trade in question."

On November 22, a gale found the vessels packed tightly together—250 was the estimate—and the destruction resulting was terrifying. "The Battle of Trafalgar did not present such a scene of havoc." But the shipping at Ichabo kept increasing until the peak was reached in December. On December 10, Captain Allyn left Ichabo with 500

tons of guano. He reported that there were 300 English and five American vessels, and 2000 laborers exclusive of the ships' crews when he departed. The guano was nearly gone, and a number of vessels were leaving in ballast.

About December 5 the *Thunderbolt*, which had kept a semblance of order, left the island, and rioting broke out with renewed vigor. Finally the warship *Thunderer* arrived; and her captain, wishing to make a quick end of the whole business, apportioned the guano among certain vessels and ordered the rest of the shipping off the coast. Though, by early 1845, Ichabo had been reduced almost to bare rock, cargoes of "sweepings" arrived at England as late as April.

Other West African Deposits

The long delays and extortionary methods employed at Ichabo induced many captains to experiment elsewhere. Cargoes of guano from Mercury and other African islands began arriving in Great Britain, and interested merchants reported that its quality appeared equal to that of Ichabo, though a few months previously reports indicated that no African deposit but that of Ichabo was worth bothering with. By the close of 1844 the deposits of Mercury, Angra Pequena, and Possession were practically exhausted.

At Saldanha Bay, almost down to Cape Town, there was much guano activity in 1845, with disturbances similar to those at Ichabo. Saldanha Bay and Dassen Islands were Crown property, and the Cape Government, much to the indignation of the guano merchants, served notice on November 5, 1844, that each vessel loaded should pay a tax of twenty shillings a ton, figured on her registered tonnage. A ship captain at Saldanha Bay in the spring of 1845 wrote:

> I have taken 200 tons in four weeks and think it will bring Ichaboe prices, as it is of good quality. The stench is worse than that of Ichaboe guano. The ammonia has caused the death of the superintendent of police, and several men are confined to their beds because of its effects. There is much here, and eighty-five vessels are at anchor. The *Thunderbolt* is expected to come to restore order . . . Fights occur daily; the police can do nothing and they don't try. The laborers are demanding higher wages and the seamen are demanding discharges so that they can become laborers and work for 3s. 6d. a day. Some of the vessels have to stay here months before loading.

Much money was made during the African guano boom. Theal in his "History of South Africa" estimates that about 300,000 tons were sold in England during 1844 and 1845. The average price was £7 per ton, of which the cost of shipping and landing came to about £1, freight came to over £4, and the importers cleared the remainder.

During the boom there was much interest in England in the discovery of new deposits. Early in 1844 twelve ships left Glasgow and Liverpool for the purpose of visiting other rainless coasts in quest of guano. In October, 1845, the *Rover* reported the discovery at

Ichabo of a new deposit, estimated at 40,000 tons, under a layer of rock. But captains familiar with Ichabo branded the tale as ridiculous. A chart of the world was published based on a study of bird haunts and exhibiting "certain and probable guano islands and coasts." At least one cargo of "Labrador guano" was taken to British America, and rumors told of a deposit at Caithness. Interest in manufactured fertilizers was stimulated, and several attained prominence. Many of these were simply guano to which had been added the minerals necessary to produce a more balanced fertilizing effect.

Later Years

American interest in the guano or seal coast vanished with the boom. In the late seventies the interest in bird guano was temporarily revived, and residents of New Bedford decided to see if the deposits had been rebuilt. The schooner *Delia Chase* set out for Hollams Bird Island to investigate.[10] On the island were relics of guano parties of past years, including a house fitted up with living quarters. Its corrugated roof had partly caved in from the weight of new guano, which was in places several feet thick.

"Our trip was not a success. The backers of the trip found that they could not get guano from the island on account of its being an English Possession." This futile attempt is, as far as is known, the only American voyage made to the guano islands for commercial purposes since the forties.

In the year 1861 the guano islands were annexed to the British Crown, and for many years the African guano deposits have been controlled and managed by the Government of the Union of South Africa. Only a limited amount is removed annually, and the "guano season" takes place between April and September when the birds are away from the islands. On some of the islands are small permanent settlements which depend upon vessels from Cape Town for water and provisions. The men go sealing during the off season, and when the time comes to remove the guano they are assisted by groups of laborers sent from Cape Town. On Ichabo is such a settlement—a few white men with women and children, besides a number of natives.

The Government Guano Islands, as they are now called, are the leading source of nitrogenous fertilizer within the Union.

The guano is collected, dried, cleaned, and shipped to Cape Town or to other markets within the Union. The local demand for guano is much greater than the supply, and exportation of this product is prohibited. Guano is sold by the government at £10 per ton, which is said to be lower than the price it would command in the open commercial market. In 1922 the output of the Guano Islands was 9394 tons, and in 1923 approximately 10,000.[11]

[10] Information received from Captain Edward M. Ellis of Fairhaven, Mass.

[11] Harry M. Lakin: Report on Fertilizers, Durban, 1925.

NOTES ON RECENT PRODUCTION AND MOVEMENT OF COAL IN EUROPE

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RECENT important changes have been brought about in the production and international movement of coal in Europe.[1] These changes have been an actual decrease in the amount of coal produced and consumed in 1929 as compared with 1913, an increase in the production and use of lignite, a decrease in coal production in the leading producing nation and an increase in production in many other nations most of which formerly imported the greater part of the coal used, a change in international markets and consequently a change in the international movement of coal, and a decline in the exports of the leading exporting nations. These changes have been largely due to forces generated by the World War and to recent changes in the development and use of power.

For some time Europe has been producing about half the world's supply of coal and the larger part of the world's supply of lignite. Before the World War the European coal industry was in a most prosperous condition. Between 1886 and 1913 consumption increased at the rate of slightly more than four per cent a year. Production increased accordingly and was accompanied by a gradual rise in price. Profits and wages both rose, and little attention was given to perfecting more economical methods of production.

The World War interrupted this prosperous condition. Many importing countries were unable to secure the usual amounts of coal, and what they did secure was procured only at extremely high prices. In order to protect themselves against this difficulty and against similar situations in the future these countries sought to develop their own supplies of coal and lignite and to protect these new developments by high tariff walls. A search for substitute sources of power was also instituted, and scientific developments caused marked progress to be made in efficient use of fuels. Thus Europe increased its capacity to produce coal and at the same time increased its use of substitutes and its efficient use of coal.

[1] All statistics in this study concerning production, exports, and imports of coal from 1913 to 1928 inclusive are taken from "Memorandum on Coal," International Economic Conference, published by the Economic and Financial Section of the League of Nations, Geneva, 1927, and "The Problem of the Coal Industry," Economic and Financial Section of the League of Nations, Geneva, 1929. Statistics for the year 1929 are taken from material furnished by the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce. All tonnage statistics in this study are in *metric tons* unless otherwise stated.

As the result of these developments European production of coal actually decreased 1.8 per cent from 1913 to 1928 (605,262,000 tons to 594,200,000 tons) while the combined production of coal and lignite in the terms of coal increased 1.1 per cent during the same period. This may be compared with world coal production, which increased 2.4 per cent from 1913 to 1928 while world production of

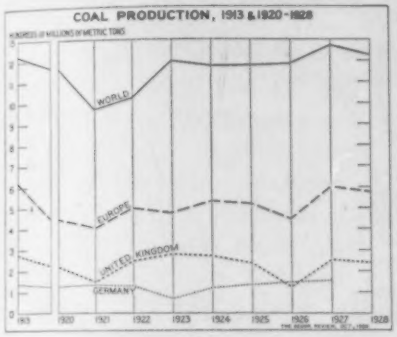

FIG. 1

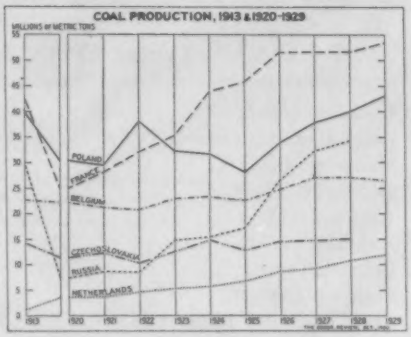

FIG. 2

FIGS. 1 and 2—Coal production of the world, Europe, and the principal coal-producing countries of Europe (figures for Russia include Asiatic territory). Figures for Germany, Poland, and Czechoslovakia for 1913 cover the territory within their present boundaries.

coal and lignite combined increased 4 per cent during the same period. Europe was thus faced with the situation of having a considerably increased productive capacity with little or no increase in consumption. This margin of productive capacity is estimated at about one-quarter in Germany, from one-quarter to one-third in the United Kingdom, and about one-half in Poland. If these three countries produced up to capacity, European production would be increased by about one-fifth. This surplus capacity in turn has resulted in unemployment and much idle equipment—difficulties that have been increased by improvements in mining methods, which have considerably increased the production per man. Thus in the Ruhr District of Germany the proportion of coal cut by the aid of mechanical power increased from 2 per cent in 1913 to 83 per cent in 1927. Similar improvements have been made in other areas until today 55 per cent of the coal produced in Scotland, 18 per cent of the coal produced in England, 73 per cent of the coal produced in Belgium, and 60 per cent of the coal produced in France is mechanically mined. Again, surplus capacity has led to a struggle among exporting countries to secure new markets or to maintain old ones in the face of increased competition.

PRODUCTION

A survey of recent changes in the production of coal by the leading European countries will demonstrate some of the present difficulties.

In addition to the causes previously mentioned, fluctuations in the production of coal have been caused by changes in general economic conditions and in economic and labor conditions within the leading producing nations. For example, the general economic depression and the three-months strike of the British miners caused a considerable decrease in production in 1921; in 1923 passive resistance to the French occupation of the Ruhr greatly reduced German

TABLE I—LIGNITE PRODUCTION BY COUNTRIES (*Metric Tons*)

Germany (1928)	166,600,000
Czechoslovakia (1928)	20,700,000
Hungary (1928)	6,500,000
Jugoslavia (1928)	4,600,000
Austria (1928)	3,300,000
Rumania (1927)	2,850,000
Bulgaria (1928)	1,400,000
France (1927)	1,067,000
Total European Production (1928)	208,400,000

production and had a slight influence on the production of the entire continent; again, the long British strike of 1926 caused a marked drop in the production of the United Kingdom and decreased the production of Europe as a whole.

In 1913 the United Kingdom produced 274,000,000 tons, which was 49.7 per cent of the total amount of coal mined in Europe. By 1928 production had fallen to 241,500,000 tons, a reduction of about 12 per cent and but 40.6 per cent of the production of the continent. In 1929, however, production increased until the United Kingdom mined about 253,365,000 long tons, which is greater than the production for any year since 1913.

Decrease in exports, including both cargo and bunker fuel, accounted for some 87 per cent of the decrease in production from 1913 to 1928. Decrease in the production of pig iron, which fell from 10,260,000 tons in 1913 to 6,610,000 tons in 1928, accounted for the larger part of the decrease in domestic consumption. Other domestic industries that slightly decreased their use of coal during the same period were the steel industry, the collieries, and general trades. Efforts have been made to remedy these conditions by decreasing the cost of production through the use of machinery and improved methods and by stimulating exports by bounties and preferential rail rates. These measures aided in increasing exports in 1929; but whether they can economically be continued indefinitely and whether their beneficial effects will be permanent is open to grave doubt. Increases in industrial activity at home may not have a great effect on the amount of coal used, as British industries are

making every effort toward more efficient use of fuel. For instance, progress is being made in low temperature carbonization of coal for the production of such products as motor fuel, Diesel engine oil, fuel oil, lubricating oil, and a solid, free-burning, smokeless fuel.

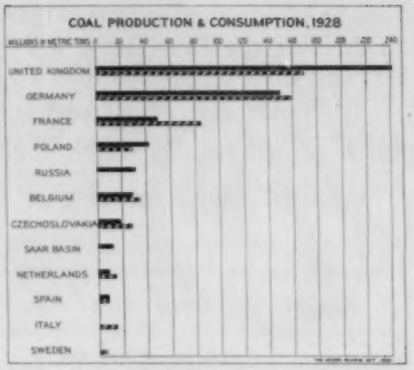

FIG. 3—Coal production and coal consumption (including coke, briquettes, and lignite in terms of coal) for principal European countries for 1928. Data from "The Problem of the Coal Industry" (see footnote 4).

Germany ranks second in importance as a European producer. In 1913 the present territory of Germany produced 140,000,000 tons of coal which was 21.9 per cent of European production. By 1928 her production had mounted to 150,900,000 tons, an increase of 7.8 per cent, or 25.4 per cent of the European supply; and in 1929 to 163,437,000 tons, the greatest amount Germany has ever mined.

Increases in German production of lignite have been even more marked—from 87,000,000 tons in 1913 to 166,600,000 tons in 1928, an increase of 91.5 per cent. Germany and Czechoslovakia together produce most of the lignite in Europe and in fact in the world.

However, the growth of the industry in Germany has not been without its difficulties. Marked increases in the use of machinery and improved methods in mining have tended to reduce the amount of labor needed, but they have also led to some unemployment and readjustment of the labor supply. The most serious difficulties, however, have come from increased competition with foreign producers for the foreign and domestic markets. British coal under the stimulus of subsidies has been successfully attacking some German foreign markets and has even penetrated into the interior of Germany. Dutch coal has also been competing effectively in certain parts of the country. The greatest handicaps that the industry has in competition with these outside fuels are high taxes and high freight rates. Preferential rail rates have been used in an effort to encourage exports and discourage imports. Part of the present German exports are reparation payments, and when these cease increased difficulties

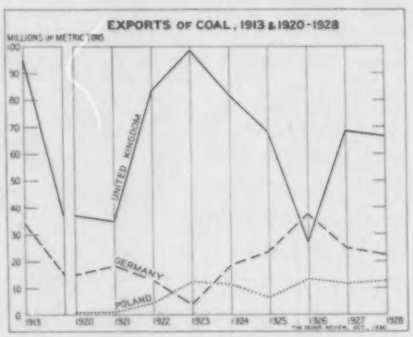

FIG. 4—Exports of coal from the United Kingdom, Germany, and Poland, 1913 and 1919–1928.

may be encountered in foreign markets. By 1935, if not before, it seems likely that the Saar Basin will be returned to Germany; and this will add some 13,000,000 tons a year to the production of the nation.

In France, also, an increase is to be found. In 1913 France mined 43,847,000 tons of coal, and by 1928 the amount produced had risen

TABLE II—DESTINATION OF COAL EXPORTS FROM THE UNITED KINGDOM

(*Long Tons*)

EXPORTS TO	1913	1924	1928	1929
Russia	5,998,000	38,000	24,000	34,000
Sweden	4,563,000	3,550,000	1,539,000	2,336,000
Germany	8,952,000	6,824,000	5,367,000	5,521,000
France	12,776,000	14,535,000	9,065,000	13,045,000
Italy	9,647,000	6,706,000	6,662,000	7,095,000
Denmark	3,034,000	3,551,000	1,731,000	2,194,000
Netherlands	2,018,000	2,744,000	2,434,000	3,123,000
Belgium	2,031,000	3,330,000	2,259,000	4,140,000
Spain*	.....	.....	1,867,000	1,783,000
North America	171,000	5,555,000	1,003,000	1,080,000
South America	6,978,000	4,637,000	4,776,000	5,043,000
Africa	6,597,000	4,619,000	4,877,000	5,047,000
Irish Free State	.....	.....	2,423,000	2,456,000
Bunkers	21,024,000	17,689,000	16,729,000	16,420,000
Total	94,424,000	79,340,000	66,780,000	76,697,000

*Statistics concerning Spanish imports are not available for 1913 and 1924.

to 51,400,000 tons, or an increase of 17 per cent, exclusive of the production of the Saar Basin, which is at present within the French Customs Union. In 1929, the greatest year in French production, it is estimated that 54,956,000 tons were mined.

Poland shows a slight decrease of .9 per cent in the amount of coal mined from 1913 to 1928. The 1913 statistics are based on the production of the territory now included within Poland. However, the recent rise in production has been rapid—27 per cent from 1924 to 1929.

Production for the present territory of Russia, both European and Asiatic, rose from 23,765,000 tons in 1913 to 34,500,000 tons in 1928, an increase of 45 per cent. Recent progress has been especially marked, the increase from 1924 to 1928 being 117 per cent.

In Belgium production rose from 22,842,000 tons in 1913 to 27,500,000 tons in 1928, an increase of 20.3 per cent. Unlike most of the other countries studied, the production for 1929 was slightly less than that for 1928.

The production of coal in Czechoslovakia has increased 6.5 per

cent from 1913 to 1928. This nation is also important in the production of lignite, producing in 1928 20,700,000 tons as compared with 15,200,000 tons of coal. Present lignite production, however, is not equal to that within the same territory in 1913.

The Netherlands show the greatest percentage of increase of all nations in Europe—from 1,873,000 tons in 1913 to 11,613,000 tons

TABLE III—DESTINATION OF COAL EXPORTS FROM GERMANY (*Metric Tons*)

EXPORTS TO	1913	1924	1928	1929
Belgium	5,728,000	3,353,000	4,112,000	4,939,000
France	3,243,000	5,017,000	4,597,000	5,260,000
Netherlands	7,218,000	5,256,000	6,690,000	7,179,000
Italy	968,000	4,358,000	4,185,000	4,827,000
Czechoslovakia	.....	402,000	1,451,000	1,426,000
Other countries	17,109,000	679,000	2,860,000	3,138,000
Total	34,266,000	19,065,000	23,895,000	26,769,000

in 1921, an increase of about 575 per cent. Increases are also marked in other countries whose production is less important—in Spain, Austria, and Sweden—while that of Hungary showed a slight decrease. Spitsbergen, most of whose supply goes to Europe, increased its production from 36,000 tons in 1913 to somewhat over 350,000 tons in 1928.

EXPORTS

There are today only three nations in Europe important for their coal exports: these are the United Kingdom, Germany, and Poland in the order named. The United Kingdom is considerably more important than the other two combined. The location of many of its most important mining areas on or near the coast gives it the advantage of cheap water transportation to the consuming regions of Europe. It is estimated that 40 per cent of British coal is produced in definitely coastal areas and that the average rail haul for export coal is twenty-five miles.[2] This advantage gave the United Kingdom a dominant place in the exporting field and was largely responsible for an export of 95,934,000 tons in 1913, about a third of her production. By 1928 this amount had fallen to 67,653,000 tons, a reduction of 29.5 per cent. In 1929, owing in part to stimulation by export bounties and preferential rail rates, exports rose to about 76,600,000 tons. The great reduction in exports is largely due to increased production in the areas to which Britain previously exported, to

[2] R. C. Smart: The British Coal Industry, *Fortnightly Rev.*, Vol. 131, 1929, pp. 773–787; reference on p. 776.

increased competition for foreign markets especially on the part of Germany and Poland, to the increased use of oil and water power, and to the more efficient use of fuels.

The first of these factors has already been noted. The surplus productive capacity of Germany and Poland has caused them to

TABLE IV—DESTINATION OF COAL EXPORTS FROM POLAND (*Metric Tons*)

EXPORTS TO	1924	1928	JAN.-NOV. 1929
Austria	2,899,000	2,997,000	3,022,000
Hungary	648,000	718,000	860,000
Czechoslovakia	492,000	1,069,000	854,000
Denmark	.....	1,528,000	1,586,000
Sweden	.....	2,804,000	2,378,000
France	.....	367,000	697,000
Italy	.....	445,000	532,000
Other countries	7,493,000	2,934,000	2,804,000
Total	11,532,000	12,862,000	12,733,000

In 1924, owing to abnormal conditions occasioned by the French occupation of the Ruhr, Germany imported 6,813,000 tons of coal from Poland. When conditions returned to normal German imports declined, until in 1928 Germany imported only 133,000 tons from Poland.

become increasingly active competitors for foreign markets. This competition has been rendered more effective through reduced costs of production, especially in Germany, by the increased use of machinery and increased human efficiency. For example, the output per man shift increased about 26 per cent in Germany between 1913 and 1928.[3]

The increased use of substitutes has also been of some importance. For instance, the fall in exports of bunker coal from 21,360,000 tons in 1913 to 16,797,000 tons in 1928 is in large part coördinated with the increase in the proportion of the world merchant marine using oil as a fuel—3.4 per cent in 1914 and 38 per cent in 1928. The use of hydro-electric power has also increased. It is estimated that in Italy alone this increase is equal to a coal consumption of some nine million tons a year. The demand for coal in many markets has also been checked by the rapid progress made in the technique of using coal. It is estimated that in Germany, for instance, an economy of ten per cent in the use of coal has been brought about. To the British this improved technique not only has meant unemployment and idle equipment but also has had a detrimental effect on shipping, since coal was formerly much used to provide cargoes for outgoing vessels which had come in laden with food or bulky raw materials.

The direction of the movement of coal has also changed. Exports

[3] *Ibid.*, p. 781.

from Great Britain to Russia, nearly 6,000,000 tons in 1913, today have nearly disappeared. Exports to the Scandinavian Peninsula have declined through competition from Poland. Exports to France declined till 1929 but in that year reached new levels. Exports to Italy have declined. Exports to Belgium and the Netherlands are slightly

TABLE V—PRODUCTION OF COAL IN THE SAAR BASIN (*Metric Tons*)

YEAR	PRODUCTION
1913	12,100,000
1920	7,733,700
1924	14,032,000
1926	13,107,000
1927	13,596,000
1928	13,107,000

TABLE VI—MOVEMENT OF COAL FROM THE SAAR BASIN (*Metric Tons*)

EXPORTS TO	1926	1927	1928
France	5,497,000	4,422,000	4,473,000
Germany	872,000	1,142,000	1,285,000
Italy	518,000	474,000	527,000
Switzerland	405,000	451,000	412,000
Belgium-Luxemburg	317,000	278,000	299,000

greater than in 1913. Exports to South America and Africa have both declined.

German exports declined 30.3 per cent from 1913 to 1928 and 20.4 per cent from 1913 to 1929. Recently, however, they have been on the increase, rising 25.3 per cent from 1924 to 1928. As most of the German coal fields are from a hundred to a hundred and fifty miles from the sea, coal exports have usually traveled by rail or inland waterways and have gone for the most part to adjoining countries. In 1913 the Netherlands, Belgium, France, and Switzerland were the most important markets in the order named. In 1928 the Netherlands were still first but had declined in importance. France had risen in importance and stood second, while exports to Italy had increased by nearly 1,300,000 tons since 1913 and given that country third place. Belgium had declined in importance and ranked fourth, and the only other countries of any importance were Austria, Switzerland, and Czechoslovakia, all of which had declined in the amounts received.

Poland increased its exports by about 11 per cent between 1924 and 1928. In the latter year these exports amounted to 12,862,000 tons. Of this amount Austria, Czechoslovakia, Hungary, Germany, and Danzig combined received 4,244,500 tons, an increase of 19 per

cent over the previous year. The Scandinavian countries received 3,980,000 tons, an increase of 23 per cent over 1927; the Baltic States 1,114,000 tons, an increase of 55 per cent over the previous year. The other exports were widely distributed. Poland's most important coal fields lie nearly four hundred miles from the sea, and an effort has been made to overcome this handicap by allowing preferential rail rates for export coal.

If coal and lignite both are considered, Czechoslovakia may be classed as an exporting nation. In 1928 this nation exported 1,675,000 tons of coal and 2,999,000 tons of lignite, while it imported 2,462,000 tons of coal and 34,000 tons of lignite. Most of the coal exported goes to Austria, and most of the lignite to Germany.

Other countries exporting considerable amounts of coal are the Netherlands, Belgium, and France. However, all three of these nations import more than they export. If the present trend continues, it is not impossible that the Netherlands may eventually be classed as an exporting nation. An import balance of 8,083,000 tons in 1913 declined to only 1,839,000 tons in 1928. Although definite data are lacking for Russia, that country is importing much less coal than formerly and is beginning to export small amounts. In 1928 Russian coal began to find its way into the markets of Italy, Canada, and the United States. In 1929 these exports increased materially, and the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce estimates that during that year Russian exports to Italy would amount to some 200,000 tons and to the United States and Canada another 200,000 tons. Most of the coal exported from Russia is anthracite.

Conclusion

Various national measures have been adopted to aid the coal industry in particular countries. Import duties have been raised in many of the smaller producing nations. Other nations used an import licensing system. Direct government subsidies to aid exports have been given in Spain and the United Kingdom; and indirect subsidies in the form of preferential rail rates are common. National agreements among mine owners and export subsidies by the industry itself have also been tried. The results of such measures have been to cause one country to gain at the expense of others, to bring retaliation by others, to lower prices, and to increase trouble generally. They have retarded rather than aided the forces that might reduce the gap between productive capacity and demand and thus provide a permanent remedy.

Realizing the limitations of national measures, the Economic and Financial Section of the League of Nations called together a group of

experts from all the important producing and consuming nations to consider the problems of the coal industry and if possible to recommend remedies for existing difficulties. For the European situation they recommended an international agreement to abolish all artificial restrictions to trade in coal and all artificial stimuli to production. They also suggested that the producing nations reach an agreement concerning markets, output, and prices. They proposed the setting up of an international committee representing all elements interested in the coal industry and advocated measures for assimilating, if not equalizing, wages, hours, and social conditions of labor.[4] Whether these suggestions provide an adequate solution may be open to argument, and whether they will be adopted is still more uncertain. However, many groups within the industry have reached the point where they argue that some form of international action offers the only hope for providing a permanent and effective remedy to the difficulties brought about by recent changes in the production and international movement of coal in Europe.

[4] "The Problem of the Coal Industry," Economic and Financial Section of the League of Nations, Geneva, 1929. See also review in this number of the *Geographical Review*.

THE NEW MAP OF CHINA*

George B. Cressey

Clark University

TRADITIONAL China may be said to consist of 18 provinces. These include the area to the south of the Great Wall which is often loosely referred to as China Proper. Even these provinces have had a changing history, for during the nineteenth century several pairs of them were united, as for instance Shensi and Kansu which were known as Shenkan, and Kwangtung and Kwangsi, known as Liangkwang. In addition to the 18 provinces there were also the outer territories of Manchuria, Mongolia, Chinese Turkestan, and Tibet. This traditional alignment no longer holds. The situation in 1930 is presented in the map, Figure 1.

The land of the Manchus has been divided into three provinces since 1903, known as Heilungkiang, Kirin, and Fengtien. Fengtien province has also been called Shengking but in 1928 was renamed Liaoning by the Nationalist Government in Nanking. Most old maps of Manchuria show a considerable area east of the Khingan Mountains as belonging to Mongolia and labeled the Eastern Gobi. This region is not at all a desert and has almost nothing in common with real Mongolia. For many years it has formed a part of Fengtien. The province of Heilungkiang nominally extends west of the Khingan Mountains into geographical Mongolia, here known as Barga. After the invasion of the Soviet troops at the time of the crisis over the Chinese Eastern Railway in 1929, the Mongol inhabitants of Barga attempted to set up an independent government patterned after that of Outer Mongolia. This attempt has partially succeeded, for Chinese jurisdiction is temporarily confined to the railway zone between Hailar and Manchuli.

The status of Mongolia is complicated, for it has always been rather loosely connected with China. The portion lying next to the Great Wall and south of the Gobi Desert is known as Inner Mongolia. After the Revolution of 1911 this section was divided into five parts. The easternmost area, lying really in Manchuria, was assigned to Fengtien, now Liaoning, while the remainder was divided into the special administrative districts of Jehol, Chahar, Suiyuan, and Sitao. Since Sitao contains very few people it was placed under the control of Kansu. These special administrative districts also included the

* This paper is based on studies made possible through a Grant-in-Aid received from the Social Science Research Council in 1929.

FIG. 1—The political divisions of China, 1930. Scale approximately 1 : 30,000,000.

territory north of the Great Wall shown on some maps as belonging to Chihli and Shansi. On the establishment of the Nationalist Government in 1928, these districts were raised to the status of full provinces. The area of Sitao was enlarged by the transfer of Ningsia tao (a tao is a group of hsien, or counties), formerly in Kansu, and the name of the newly created province was changed to Ningsia. Five hsien formerly in Chahar were transferred to Suiyuan, and all of northwestern Chihli outside the Nankow branch of the Great Wall was added to Chahar.

TABLE I—POPULATION AND AREA OF THE PROVINCES OF CHINA

PROVINCE	CAPITAL	POPULATION (*Post Office Estimate, 1926*)	AREA (*Square Miles*)
Anhwei	Anking	20,198,840	57,439
Chahar	Changchiakow (Kalgan)	2,166,196	101,476
Chekiang	Hangchow	24,139,766	36,472
Chinhai (Koko Nor)	Sining	795,072*	158,910
Fukien	Foochow	14,329,594	46,514
Heilungkiang	Tsitsihar	4,632,074	219,274
Honan	Kaifeng	35,289,752	63,843
Hopei (Chihli)	Peiping (Peking)	29,945,786	56,116
Hunan	Changsha	40,529,988	83,921
Hupei	Wuchang	28,616,576	71,234
Jehol	Chengteh (Jehol)	4,517,661	72,008
Kansu	Lanchow	5,815,680	159,934
Kiangsi	Nanchang	27,563,410	67,300
Kiangsu	Chinkiang	34,624,433	39,100
Kirin	Kirin	5,633,186	105,003
Kwangsi	Nanning	12,258,335	80,972
Kwangtung	Canton	36,773,502	90,247
Kweichow	Kweiyang	11,291,261	72,058
Liaoning (Fengtien)	Mukden (Fengtien)	13,775,559	100,246
Ningsia (Sitao)	Ningsia	812,066*	112,831
Shansi	Taiyuan	12,005,735	66,265
Shantung	Tsinan	34,375,849	57,851
Shensi	Sianfu	17,222,371	76,382
Sikang (Chwanpien)	Tatsienlu	not obtainable	133,579
Sinkiang (Chinese Turkestan)	Tihwa (Urumtsi)	2,688,305	550,340†
Suiyuan	Kweihwa-Suiyuan	2,423,344	113,758
Szechwan	Chengtu	52,063,606	156,675
Yunnan	Yunnanfu	11,020,591	147,849
Total		485,508,538	3,097,597

*Incomplete data, dealing only with the parts formerly in Kansu.
†Not based on map measurements by the writer.

The remainder of Mongolia, lying next to the Siberian border and comprising most of the Gobi, is known as Outer Mongolia. There are no established boundaries in Mongolia, and the few diplomatic records merely refer to the limits of tribal grazing grounds. The recent history of this region has been a checkered one, with China and the Soviet Union both striving for mastery. After the Revolution of 1911 in China Mongolia proclaimed her independence and set up her own government. A year later Russia pledged her assistance in maintaining an autonomous régime, and in 1913 China agreed to this autonomy. Russia at the same time recognized China's basic suzerainty over Outer Mongolia. This status was confirmed in

a tripartite agreement in 1915 between China, Mongolia, and Russia; and Chinese citizens in Mongolia were granted extraterritorial privileges. During the Russian Revolution Mongolia was invaded first by Chinese and then by White Russian and later by Red Russian armies. The most recent agreement between China and the Union of Socialist Soviet Republics is the Sino-Soviet Treaty of May, 1924, in which it was recognized that Mongolia is an integral part of the Republic of China, although Russia's special interests were acknowledged. Outer Mongolia was not a party to this agreement and in November, 1924, adopted a constitution which declares the country to be an independent soviet republic. There is no Chinese control at the present time, and for all practical purposes Outer Mongolia is a protectorate of the Soviet Union.

The vast territory of Chinese Turkestan was given the rank of a province in 1878 and is more properly known by its Chinese name of Sinkiang. Owing to its remote location (the normal caravan journey from Peking to Kashgar requires about 125 days) the political control has been loosely administered, but it has nevertheless been customary to exchange telegraphic confirmation of appointments. Russian influence has always been felt in Sinkiang, and the completion of the new Russian railway east of Lake Balkash will doubtless tend to weaken Chinese control.

Chinese jurisdiction over Tibet dates from the early days of the Manchu Dynasty, although there were occasional contacts before that time. A treaty between China and England in 1906 recognized China's suzerainty and was followed by another treaty the next year between England and Russia which confirmed China's authority. Tibet did not willingly accept this situation, and during the Revolution of 1911 in China the Chinese amban at Lhassa was killed and all Chinese driven out of Tibet. In 1914 a treaty was drawn up between China, Tibet, and England. It was initialed but never signed by China; England and Tibet proceeded to sign, but the present status of the treaty is undecided. Under this convention Tibet was divided into two sections, Nearer and Farther Tibet, so named on account of their position with respect to China Proper. The whole of Tibet was recognized as being under China's suzerainty; but Farther Tibet, which includes Lhassa and most of the plateau, was to be more or less autonomous. This latter condition is the actual situation that has prevailed during recent years, and China has exercised no real jurisdiction. The Nationalist Government has recently appointed a Committee on Mongolian and Tibetan affairs and is attempting to reassert its former authority in these areas.

Nearer Tibet comprises the mountainous borderland next to the old limits of China. This region consists of two parts, for several years classed as special administrative districts but in 1928 organized

as provinces. That to the south lies largely in what was formerly western Szechwan and is known as Sikang or Chwanpien. The northern province is Chinhai, or Koko Nor, and includes Sining tao which formerly was a part of Kansu. As is the case along the northern borders of the new tier of provinces in Inner Mongolia, the western limits of these new provinces are vague and the boundary fluctuates with the varying strength of the local military authorities.

In addition to these new provinces there have been a number of changes in the older ones. After the Nationalist advance to North China, the province of Chihli was renamed Hopei. Chihli means "direct rule" (from the throne), while Hopei means "north of the (Yellow) river." The former metropolitan district of Ching Chao around Peking has been abolished, and the name Peking has been altered to Peiping. The latter means "northern peace" rather than "northern capital" and is the name borne by the city during the time, before 1416, when the Ming Dynasty was located in Nanking.

The northern boundary of Shensi is shown on most maps as coinciding with the Great Wall, but such is not the case. Maps of the Chinese Military Staff place the boundary some distance outside the wall to include the strip of territory that is tributary to the towns along the line of the wall. The leased territory of Weihaiwei has recently been returned to China by Great Britain and now forms a part of Shantung.

The areas of Table I[1] are based on the new boundaries and are derived from planimeter measurements of a new map, drafted on Bonne's Equal Area Projection with a scale of 1 : 5,000,000. It is not yet possible to make an entirely accurate map of China, for there are large areas without even reconaissance surveys.

The figures of population are derived from the latest estimates of the Chinese Post Office, published in 1929. These figures are given by hsien classified according to postal districts, so that it is necessary to redistribute them in order to secure provincial totals. On account of the topographic diversity of many of the provinces it has not seemed worth while to give the figures of population density by provinces. Such figures are much more significant when based on geographic regions and have been published by the author elsewhere.[2] The subject of China's actual population is a controversial question,[3] and the total given in the 1926 census is one of the largest ever proposed. In almost every case detailed counts in sample areas show higher figures than were previously suspected, and the burden of the evidence is all in favor of a population in excess of 400,000,000.

[1] This table is taken from a forthcoming book by the writer entitled "The Geography of China."

[2] "The Geographic Regions of China," *Annals Amer. Acad. of Polit. and Soc. Sci.*, issue entitled "China," 1930.

[3] See the reference to the problem in its historical setting in A. P. Usher: The History of Population and Settlement in Eurasia, *Geogr. Rev.*, Vol. 20, 1930, pp. 110–132.

MAN IN GREENLAND: A REVIEW*

Vilhjalmur Stefansson

THESE two illustrated folio volumes, which, with a first volume on the discovery, exploration, and nature of Greenland,[1] contain 1458 pages, deserve to be called monumental. The plan is thorough, covering an island of continental size under the head of nearly every pertinent science. Much of this is source material, the direct report of scientists or other travelers of shorter or longer residence in Greenland. Even compilation ceases to be quite second-hand when it is done by men who have personal knowledge. The volumes are as useful and important as they are comprehensive. They are indispensable to every serious student of Arctic history, anthropology, and geography.

But the scholarship of this ponderous work is not always faultless, as shown by disagreement between authors within the book and by the ignoring or contradiction of other authorities who are not contributors. Parts of the books, too, were apparently either written in English by men whose command of the tongue is not idiomatic or else they were written in Danish and carelessly translated.

Greenlanders of the Present Day

One of the finest and longest papers, that of Birket-Smith on "The Greenlanders of the Present Day" (Vol. 2, pp. 1–207) is authoritative and valuable in its first-hand material, although a bit uncertain in the historical introduction of fourteen pages.

The reader is told (p. 3) that "Barely 450 km from the east coast of Greenland, Iceland emerges from the Atlantic; then follow the Faroes and, finally, Scandinavia. These are the pillars of the bridge which in the first instance carried the nations of Europe across the ocean." The criticisms of this passage are two: first, the implication that it was Scandinavians who first made the leap from the Faeroes to Iceland, while the Irish did this at least half a century before the Norse. The second criticism is that even the Norsemen found Iceland by having first reached the British Isles and then the Faeroes. The corollary follows that when they sailed on to Iceland near the middle of the ninth century they found a land not only already occupied by the Irish but a land of which they had previous knowledge from Ireland, if indeed they were not following Irish sailing directions.

Again it is said (p. 4) that in Greenland "for the first time, one of the nations of Europe encountered one of the peoples of the New World." But the sagas state plainly that the first European contact with American people, either Eskimo or other, was not in Greenland but farther west on the shores of those countries now called America.

Eric's discovery of Greenland (p. 10) is given as "985 or 986," which is the ordinarily accepted date not for the discovery but for the colonization. The discovery was three or four years earlier, probably in 982. A few lines further on there is a faulty translation from the Old Norse, where the Danish author gives the rendition: "which made it clear that the same kind of people had lived there (in Greenland) who had peopled Vinland," while the original really says "the same kind of people had

*M. Vahl, G. C. Amdrup, L. Bobé, and A. S. Jensen, edits.: Greenland, Vol. 2: The Past and Present Population of Greenland; Vol. 3: The Colonization of Greenland and Its History until 1929. Published by The Commission for the Direction of the Geological and Geographical Investigations in Greenland. C. A. Reitzel, Copenhagen: Oxford University Press, London, 1928 and 1929.

[1] See *Geogr. Rev.*, Vol. 19, 1929, pp. 338–340.

traveled there" (or "been there"). The reader is informed that the Icelandic historian Ari compares certain relics with "those of the Greenland Skraelings." But Ari distinctly compares them with those not of Greenlandic but of American (Labrador) Skraelings.

These examples will indicate that Danish historical and linguistic scholarship, at least as reflected in the present volume, is not on a very high level when it deals with the early Norse records of Greenland. It is in fact as safe as most generalizations to marvel at the average superiority of Norwegian, German, or even British scholarship in Old Norse matters over the Danish. In Denmark there is resident the very highest of Old Norse authorities, Finnur Jónsson; but he is an Icelander.

The curious point in this Danish weakness is that the Danes have for the last several centuries been in close governmental relation with Iceland. Why do they remain so remote from it intellectually? Is there perhaps some fatality about it, as in the corresponding general difficulty which the English seem to have in understanding the Irish? Does the Irish-English and Icelandic-Danish type of political union tend to disunite peoples intellectually?

This curious, or at least noteworthy, opposition between Norwegian and Danish scholarship appears again with regard to Greenlandic history. The author says (p. 11): "It is now generally accepted that, about the middle of the 14th century, the most northerly and smallest of the two settlements, the Vestribyggd (*sic*) . . . was destroyed by the Eskimos." The same view of "final destruction" is applied to the southern settlement (p. 12). Why ignore Nansen's extensive compilation of evidence and arguments of a contrary sort in his "In Northern Mists?" And why imply that a certain theory, which is no more than a favorite theory in Denmark (if there), is the only theory that deserves consideration?

The author says (p. 12), of Eskimo traditions of the alleged destruction of the colony in Greenland, that "there is no reason to doubt their reliability." Here again is a rather sharp slap at Nansen, who has argued with great learning, both bookish and founded on his personal knowledge of human nature, Eskimo and Norse, that the colonies could not have been subject to any "final destruction" but must have merged gradually with the Eskimo population. Unaware that I am peculiar in it, I find myself siding with Nansen against the popular Danish view.

Perhaps these rather blunt criticisms of the first twelve pages of "Greenlanders of the Present Day" may already have led the reader of this review to forget the paragraph of general admiration with which I began. I must, then, state specifically that the reasons for unfavorable comment decrease and those for admiration grow as the reading of Birket-Smith's paper proceeds.

It is, for instance, novel in books, but right in my opinion, to insist, as Birket-Smith does (p. 13), upon the fallacy of previous writers who have generally assumed that the districts that would be unfavorable for European agriculturists or fishermen would necessarily be unfavorable for the Eskimos. The author properly says or infers both here and in many other places that the very conditions assumed as unfavorable are frequently advantageous. For instance, there is no point in the hitherto much-respected argument that an (assumed) lowering of the temperature would increase the sea ice in such a way as to drive North Greenlanders south, crowding the northern Eskimos down upon the Norsemen and precipitating a conflict. The Norsemen, as people of a European culture, would have been so affected; but neither Eskimos nor any Norsemen that may have adopted Eskimo culture would feel that effect. Pushing the argument further, Birket-Smith shows that a decrease of floating sea ice in southern Greenland is more likely to have forced southern Eskimos north into a conflict with the Norsemen. For if the ice decreased the seals brought by the ice would decrease too, with resulting hard times for the Eskimos.

The Birket-Smith paper when it once gets away from entanglements with Old Norse literature becomes an excellent summary of what is generally known by stu-

dents, with frequent original contributions and many additional points that are novel to anyone but the most intensive specialist. For instance, he points out (p. 17) the folly of previous students, no matter how well informed, who have drawn lines on a map bounding the possible territories of Eskimo habitation on the theory that beyond these boundaries an Arctic people could not subsist. Most of these theoretical boundaries have been discredited later by field study, and if some theorizers have had better luck the emphasis must be put on their luck rather than their prescience.

The general reader will be surprised when he reads (p. 43) that: "Among the many popular errors regarding Arctic conditions is also the one that the Greenlanders are particularly small of stature." Birket-Smith traces the theory of Eskimo smallness to Claudius Clavus, born in 1388, who described the Greenland natives as pygmies. But the present reviewer would trace it still farther back, to the Greek, Roman, and medieval European belief that there were pygmies in the remote North. The author goes on to say (p. 45) that "in anthropometry only such peoples are characterized as small where the average height of the men is below 160 cm." The West Greenlanders, and that means most of the Greenlanders, have an average of 162 centimeters, while in some Greenland districts the average is as high as 169 centimeters, and many territories outside Greenland average higher than 162 centimeters.[1] Birket-Smith concludes: "The average height of the Greenlanders corresponds with the one prevailing in western France and large parts of Italy and Spain" and says that, while the Japanese and Siamese belong fairly speaking to a small people, the Eskimos should be classed with those of medium stature.

Another point which will surprise the general reader is the proof of a high birth rate among the Greenlandic Eskimos. Still more surprising is what Birket-Smith at least makes appear to be a fact, that the rate is no higher among the mixed bloods than the full bloods. There is a way, however, if one would be logically skeptical of this last deduction, to query just what he means by a "full blood." A devoted adherent of the Nansen views will put the argument against Birket-Smith somewhat as follows: Through first wrongly assuming that the Norse colony disappeared by extermination rather than amalgamation, the Danes have arrived at the wrong conclusion that the Eskimos of Frobisher's time were absolutely or at least practically, full blood. If that assumption be granted, it can be said that since Frobisher there has not been enough time or quite enough opportunity for white blood to penetrate to every corner of inhabited Greenland.

It is on this weak theorizing only, say the Nansenites, that the Danes can arrive at the conclusion that there are any full bloods in West Greenland south of Melville Bay. What the author is therefore really doing is comparing people whom he arbitrarily calls full bloods with others whom he arbitrarily distinguishes as mixed bloods. In other words, speaking from the Mendelian point of view, he calls those Eskimos "full blood" who have brown eyes with blue-eye quality latent in them but calls "mixed" those in whom the blue eye visibly appears.

The author gives perhaps inadvertent support to the Nansen view by saying that even the pure-blood Eskimos look a great deal like Europeans (p. 42). He gives stronger support by admitting that half-breeds look extremely European, for it has been clearly shown in Alaska, where the first white men arrived within the memory of natives still living, that no child of an Eskimo mother and white father ever has had blue eyes. But blue (or gray) eyes seem frequently to be considered normal by the Danes in Greenland as the result of a marriage of a full-blood European with one of the so-called full-blood Eskimos. The hard-boiled biologist will conclude that you find this difference between Alaskan and Greenland "full bloods" because the Greenlanders are full bloods in name only. That brings one back to the non-Danish view—that the Norse colony disappeared by amalgamation and not by destruction.

[1] See Diamond Jenness: Physical Characteristics of the Copper Eskimos, in Report of the Canadian Arctic Expedition, 1913–18, Vol. 12, Part B, Ottawa, 1923, p. 50B, table.

There is inconsistency where it is admitted (p. 55) that a theory of medieval Norse intermarriage with the Eskimos "has frequently been propounded with a view to explaining the destruction of the Eastern Settlement," while the rest of the paper up to this point has been written as if no such theory existed. Here too it appears that on previous pages our author may have been careless of his English, or that there may have been a bad translation, for he here uses the word "half-breed" as if it meant any person not pure Eskimo, while it has seemed to this reviewer that heretofore he really meant half-breed when he said half-breed—i.e. a person who is half one and half the other.

Among the conclusions that are somewhat novel to the lay reader are these (p. 51): that "the only sense which presumably is more developed with them [the Eskimos] than with us is the smell" and (on the same page) that the exclusive or nearly exclusive flesh diet "cannot be proved to exercise a harmful influence upon their health."

When it comes to such things as the descriptions of "Habitation and Clothing" (pp. 56–105), this reviewer finds nothing with which to disagree; and that should, I think, be credited to the author's success rather than to the reviewer's failure. I know he is right, for instance, when he says that "the snow house . . . is a warm and highly serviceable dwelling" and that in comparison "it is far from pleasant to live in tents during the Arctic autumn" (while as yet it is not cold enough for the use of snow houses).

It is scarcely worth mentioning that on the basis of having built hundreds of snow houses myself I do not find the description of snow house building quite clear or wholly correct, as, for instance, where it is said (p. 80) that each block as the house rises "is made fast with a powerful thrust of the hand." Houses frequently have to be built out of snow that must be delicately handled or it will crumble. A house destined when built to be solid and secure may be so unstable, and the blocks so weak while you are building, that you hardly dare to breathe on them. True enough, any builder may employ "a powerful thrust of the hand" when he is handling ideal snow and then especially if he is in a hurry.

The section on "Economic Life" (pp. 105–160) is similarly admirable, and the reviewer is able to offer few comments that may even possibly be of value unless to suggest (pp. 125 and 131) a solution to the apparent mystery of why there is folklore about seal nets on the east coast of Greenland and why John Davis mentions fish nets for the west coast in the sixteenth century. It has been generally agreed that the fish or seal net is not "originally" an Eskimo possession. By combining my own archeological and ethnological work, for instance, I thought myself able to prove that the fish net arrived at the mouth of the Mackenzie River from the west within the last century and that it never penetrated along the north coast of North America east beyond Cape Parry. There is a ready solution for the exceptional occurrence of nets in Greenland through the well known fact that the Norsemen had nets there during the Middle Ages and that the Eskimos must have seen them in use. Outside Greenland they are known to have borrowed nets readily whenever they came in contact with net users, European or Indian. Why not similarly in Greenland?

The sections on "Communication" and "Home Life" are equally admirable and bring us to the end of this paper.

Intellectual Culture

The essay on "Intellectual Culture of the Greenlanders" (pp. 209–270) is written by a master of the language, C. W. Schultz-Lorentzen, but still I can agree neither linguistically with his translation of *amaut* nor ethnographically with the implication of that translation (p. 216) that Greenland women, or any Eskimo women anywhere, carry babies in the hoods of their coats. It is at bottom only a matter of common

sense. Think of any hood to a coat and imagine it thrown back. If it contains a weight the pressure will come on the front of the throat, buckling the cartilage of the windpipe and producing difficulty of breath if not strangulation.

Knud Rasmussen, born in Greenland, himself no doubt carried about in his infancy by Eskimo women, and the observer of thousands of such cases in maturity, says: "The women in Greenland have never in the past carried their children in their hoods, nor do they do so now." He adds: "The child is . . . carried on the back in a small pouch in the coat and decidedly not in the hood, as that would simply choke the mother."[3]

Birket-Smith has remarked in these volumes, as quoted above, how strange it is that Danes still follow an author of the fourteenth century and continue supposing the Eskimos to be a small people after two hundred years of intimate Danish association with Greenland. It is more strange that Danish scientists, specialists in Greenlandic knowledge, have been victimized by this baby-in-the-hood canard, a bit of pseudoscience that does not even go back to the superstitions of the Middle Ages. Crantz describes the pertinent custom rightly, to the effect that the women carried babies inside of a roomy coat, the child supported by a belt at the mother's waist.[4] Similarly Egede, writing about 1757, has the correct description.[5] Kleinschmidt, who published his dictionary[6] as the result of a lifetime of residence in Greenland, defines the roomy coat inside which babies are carried and has no suggestion that they are either rarely or usually carried in hoods. In fact, the idea of hood carrying seems newish among the Danes.

Have the Danes perhaps been misled by the British travelers of around a hundred years ago? Parry in 1824[7] and Lyon in the same year[8] have the babies carried in hoods, and they are talking about the Eskimos of the Baffin Island and King William Island region, although most particularly dealing with the vicinity of Iglulik. They were such great men, so highly regarded as precise and clairvoyant observers that enough writers have since copied their baby-carrying anecdotes to make up a Who's Who of ethnographers and explorers. Nevertheless they are not followed by such men as Captain George Comer, of East Haddam, Conn., collaborator with Professor Franz Boas of Columbia in Eskimo studies. Comer has spent five summers in Baffin Island, twelve winters among the Eskimos of the Hudson Bay region, and twenty-seven months in North Greenland. He says: " . . . the Eskimo women carrying their babies in the hood of their garment is perfectly absurd . . . Once when I spoke of the child being carried in the hood it made the [Eskimo] women laugh."[9] But there was nobody in Europe to laugh at Parry and Lyon. The fashion has prevailed; and it seems that even the Danes, who held out with at least fair unanimity so late as the last quarter of the nineteenth century, are beginning to succumb in the first quarter of the twentieth.

In regard to *erqigdlit* and *igaligdlit* it is stated (p. 231) that "these words remind us of the names given to the Indian tribes by the Alaska Eskimos." That geographic limitation is narrow. Some form of the word *erqigdlit* is used for other North American Indians, not only by the Eskimo Indians of Alaska but by most Eskimos on the American mainland and in the Canadian Arctic Archipelago.

Apart from these small comments, there is nothing to say but in admiration about Schultz-Lorentzen's discussions of "The Greenlandic Language" (pp. 211–221), "Literature" (pp. 221–226), "The Complex of Ideas of the Greenlanders"

[3] Private letter to the reviewer.
[4] David Crantz: The History of Greenland (2 vols., London, 1767), Vol. 1, pp. 138 and 162.
[5] Hans Egede: A Description of Greenland, 2nd edit., London, 1818, pp. 132 and 148.
[6] Samuel Kleinschmidt: Den Grønlandske Ordbog, Copenhagen, 1871.
[7] W. E. Parry: Journal of a Second Voyage for the Discovery of a North-West Passage, London, 1824, p. 495.
[8] The Private Journal of Captain G. F. Lyon, London, 1824, pp. 20 and 315.
[9] Personal letter to the reviewer.

and their "Conception of the Universe" (pp. 226–232), "Religious Ideas" (pp. 232–246), "Art and Games" (pp. 246–252), and "Legend and Tradition "(pp. 252–269). The selection of less than a dozen specimen folklore tales and of a corresponding number of songs seems admirable.

On the final very brief section dealing with the Greenlandic method of counting one may disagree, though perhaps about a distinction without much difference. The author says that the Greenlanders count basically by fives. Perhaps he gets that feeling from them; but my own feeling through daily use of Eskimo counting farther west over many years is that their basic idea is not five but twenty—at least that twenty with them corresponds to ten in our thinking. Eskimos do count by the first hand, the second hand, the first foot, and the second foot, as is incompletely told in this essay. But our twenty-three is in Eskimo "one man and three"; which is "twenty and three," not "four fives and three." This is counting more basically by men than by hands, by twenties than by fives.

Archeology in Greenland

"Eskimo Archaeology" (pp. 271–329) is treated by Thomas Thomsen, Keeper of the Ethnographical Department of the National Museum in Copenhagen, in a way that seems satisfactory unless it be that his comparisons are too frequently only between different things or forms in Greenland, too seldom between Greenlandic forms and those found in the rest of the Eskimo area. Perhaps this is not really a defect in a work frankly about Greenland.

The Icelandic colonization of Greenland (pp. 331–361) is treated by the greatest living authority, Dr. Finnur Jónsson, Professor of Scandinavian Philology at the University of Copenhagen. But it is frequently difficult to decide just what he means, as for instance where it is not clear whether he favors or opposes Steensby's view that Karlsefni entered the St. Lawrence River (p. 361). These troubles are probably due to faulty translation.

Perhaps the high light of the current discussion is that, while Nansen in 1911 put the maximum European population of Greenland in the Middle Ages at 2000, Jónsson now, less than twenty years later, puts it at 9000. This is an important difference from two angles: first, it shows that progressive studies, chiefly archeological, are from time to time making necessary a higher estimate for the medieval European population; secondly, this increased estimate makes it decreasingly likely that the Eskimos could have exterminated the colonists. Which, being interpreted, strengthens the view that what took place was a racial amalgamation, not a destruction of the European Greenlanders—this amalgamation probably taking place chiefly between 1400 and 1500.

Although short, Jónsson's discussion seems the best treatment to date from his or any other pen of the story of the European colony in Greenland from 985 to about 1500 A. D. One may read in it, too, an increased hope that scholarship, perhaps by unearthing records of the Bristol trade in England, may be able to expand the history of the Greenland colony this side of 1500, eventually perhaps tying it up with the Frobisher-Davis period of British exploration.[10]

A large section of the European archeology of Greenland is competently treated under the head of "Old Norse Farms" by Captain Daniel Bruun (pp. 363–403). Here, as in many other parts of the three-volume work, there are enlightening photographs and sketches.

Under the head "The Finds from Herjolfsnes," Dr. Poul Nörlund gives (pp. 405–415) what is in effect a résumé of that Volume 67 of *Meddelelser om Grønland* which was so ably summarized in the *Geographical Review* by Professor William Hovgaard.[11] The only apparent change is that Nörlund now concedes that there

[10] See the note on the Bristol Record Society elsewhere in this number of the *Geographical Review*.

[11] The Norsemen in Greenland, *Geogr. Rev.*, Vol. 15, 1925, pp. 605–616.

has been serious dispute of his former contention that he had found archeological evidence of a warmer climate at Herjolfsnes 500 or 600 years ago. The criticism he particularly refers to is by Nansen.

It is curious to find Dr. Nörlund speaking of "a race greatly deteriorated and degenerated from intermarriage" in a book published in 1929, long after most biologists have ceased to believe in the deleterious effect of consanguinous marriages *per se*.

The most important scientific exception that may be taken to the Nörlund paper is with regard to his inference that the malnutrition from which the skeletal remains show the Herjolfsnes population to have suffered was the result of inadequate commerce with Europe—he stated this in his longer work and seems to infer it in the present summary. But such deficiency troubles as are described by Nörlund in ancient Herjolfsnes are said by Alfred Bertelsen, in Vol. 3 of the same work, to be at present most prevalent among Danes in Greenland, less prevalent among Eskimos living in villages, and of small account or unknown among those living in native style. In other words, the Herjolfsnes dietetic troubles were not due to a lack of imported food but to the presence of an imported food supply which the people used to their detriment instead of the native diet, chiefly flesh foods, more wholesome because fresh.

Volume 3 is, in part at least, less interesting from the geographical point of view or at least from the angle of this reviewer. On the contributors who fill up the first 363 pages[12] we can bestow here only the praise of an outsider who likes them.

Sanitation and Health

With Bertelsen's "Sanitation and Health Conditions in Greenland" the reviewer is on more familiar ground. If only such articles as this had a wide circle of readers among doctors and dietitians! Many of them would be surprised, for instance, to read (pp. 380–381) that "the typical Greenland diet, almost exclusively consisting of animal food, does not materially influence the state of health of the native population; worthy of note is, therefore, the rare occurrence of diseases such as *arthritis urica, renal calculi* and other symptoms of uric acid diathesis. . . . *rachitis* is practically unknown."

But of even greater popular and of no slight scientific interest is the paragraph: "As a fact presumably bearing upon the diet, it is to be noted that tooth caries, which in Denmark is to be found in about 97 per cent of the population, in Greenland occurs in rather more than half of the population at the settlements, but only in a fourth at the outposts, where the manner of living is upon the whole less influenced by European civilization."

This must not be interpreted to mean that all diseases are infrequent in Greenland. Many occur there with normal European frequency and others with a higher incidence. A study of these high and low rates and how they vary in distribution, not only between Greenland and Europe but between diet classes in Greenland, will tend to modify some current dietetic views.

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[12] Types of European Colonization, by Gudmund Hatt. The status of Greenland in International Law, by Gustav Rasmussen. Trade and Administration of Greenland, by Harald Lindow. History of the Trade and Colonization Until 1870, by Louis Bobé. The Trade from 1870 to the Present Time, by H. Ostermann. The Navigation of Greenland, by T. V. Garde. The Church of Greenland of the Present Day, by Knud Balle. The History of the Mission, by H. Ostermann. The Educational System of Greenland, by C. W. Schultz-Lorentzen.

THE FIRST MAP WITH THE NAME AMERICA

Louis C. Karpinski

IN April of the year 1507 the German scholar, Martin H. Waldseemüller, called also Ilacomilus, published at St. Dié in the Vosges mountains of Alsace his "Cosmographiae Introductio,"[1] in which the suggestion is made that America be the name applied to the New World. Upon the title page, in the dedication to Emperor Maximilian, and again on the reverse side of a larger inserted leaf with the figure of a sphere reference is made to a representation of the world "tam in solido quam plano" (as well in a solid [globe] as in a plane map), made to accompany the cosmography.

In 1900 Professor Joseph Fischer found at the Castle Wolfegg in Württemberg a magnificent map in twelve sheets, corresponding to the description indicated by Waldseemüller in his Cosmography. In 1901 the distinguished cartographer F. R. von Wieser published a note about this remarkable map,[2] with the description of the map of 1507 and the Marine Chart of 1516 by Waldseemüller which was found with the map of 1507 bound in the same volume. In the year 1903 Fischer and Wieser published fine facsimiles of the two Waldseemüller maps with accompanying text in English and German. Since that date scholars have accepted the map of 1507 as the first with the name America. At the time of its discovery the map of 1507 was also the first printed map containing a delineation of the New World; but recently the British Museum acquired a map[3] with date 1506 by an Italian, Contarini, containing a representation of the New World. Scholars in general accept this map as the earliest printed map as yet known containing the New World.

The Stevens-John Carter Brown Map

Recently Mr. Henry N. Stevens of London has published a book[4] attempting to demonstrate that a map sold by him in 1901 to the John Carter Brown Library is the earliest printed map of the New World and the earliest with the name America. This map is identical in size and geographical outline with the "Orbis Typus Universalis iuxta Hydrographorum Traditionem" published in the 1513 Ptolemy. This map was purchased in 1893, but, in spite of the title statement by Mr. Stevens, it was really not "discovered" by him until 1899; for, as he explains, it was not until 1899 that the map was found to be a variant. This map has the place names on a wood-block map made by type inserted into holes cut into the block. Two place names are added, "America" and "Venetia," five are changed, and eight are omitted as compared with the 1513 map.

[1] Printed at St. Dié in April of 1507 (with a variant form) and in September of 1507 (with a variant), at Strasbourg in 1509, and at Lyons about 1518. A facsimile edition was published at Strasbourg in 1907, edited by F. R. von Wieser, and an English edition in New York in 1908.

[2] F. R. von Wieser: Die älteste Karte mit dem Namen "America" a. d. J. 1507 und die Carta Marina a. d. J. 1516 des Martin Waldseemüller, *Petermanns Mitt.*, Vol. 47, 1901, pp. 271–275.

[3] A Map of the World Designed by Giovanni Matteo Contarini, Engraved by Francesco Roselli, 1506. With a reproduction, British Museum, London, 1924. 2nd edit., revised, 1926. The map is described by Edward Heawood: A Hitherto Unknown World Map of A. D. 1506, *Geogr. Journ.*, Vol. 62, 1923, pp. 279–293.

[4] Henry N. Stevens: The First Delineation of the New World and the First Use of the Name America on a Printed Map: An Analytical Comparison of Three Maps for Each of Which Priority of Representation Has Been Claimed (Two with Name America and One without), with an Argument Tending to Demonstrate that the Earliest in Each Case is the One Discovered in 1893 and Now Preserved in the John Carter Brown Library at Providence, R. I. London, 1928.

Mr. Stevens in 1899 offered the map to Mr. John Nicholas Brown as "the first to bear the name America." The following year he submitted a written report on six propositions "originally drawn up in 1899,"[5] and subsequently the map was purchased by the John Carter Brown Library.

The six theses of Mr. Stevens, quoted from the book, are as follows:

I. That the Stevens-John Carter Brown Map is the prototype of the 1513 Ptolemy *Orbis Typus*.

II. That it was designed and prepared by Waldseemüller and his confrères of the Gymnase at St. Dié probably as early as 1505 but not later than the early part of 1506, that is to say some appreciable time prior to the introduction of printing into that town in the early spring of 1507, and consequently anterior to the publication of the *Cosmographiae Introductio* in April of that year.

III. That it was engraved at Nuremberg and printed there, probably as early as 1505 but not later than the early part of 1506, with Nuremberg type letterings on Nuremberg paper.

IV. That it is in all probability the first specimen or experimental design made for the series of maps which the St. Dié cartographers intended adding to their proposed new edition of Ptolemy, which we know had been for some considerable time in preparation prior to 1507 and was about to be printed at St. Dié in that year.

V. That it is the first printed map yet known to show any part of the New-World discoveries.

VI. That it is the first printed map on which the New-World discoveries are marked with the name AMERICA.

Mr. Stevens could not find that the paper and type of this Stevens-J. C. B. map was used at the same time in any European publications except at Nuremberg between 1505 and 1506. The argument is practically worthless, as paper and type migrated with rapidity. Furthermore, I have found both paper and type in a copy of the Apianus "Astronomicum Caesareum"[6] published at Ingolstadt in 1540. The names omitted are largely (seven out of eight) of minor importance and could easily have been left out in the desire to save work on the wood block.

The main brunt of the argument rests on a letter[7] by Waldseemüller to Joannes Amerbach of Basel written on Easter Monday, 1507, stating that they were about to print the Cosmography of Ptolemy "with maps revised and some new ones added" and most particularly upon a letter in the 1513 Ptolemy written probably by the editors, who gave no recognition to the work of Waldseemüller. With reference to the uncertain Latin of a phrase in this letter of 1513, Stevens quotes no less than fourteen authorities, *every one written before the Fischer map of 1507 was discovered.*

The likelihood that Waldseemüller put the name America upon the New World in advance of the publication suggesting the name America is remote. It could almost be qualified as absurd. The likelihood that he and his colleagues prepared a wood block with type inserts as a specimen block exists as an historical fact only in the mind of Mr. Stevens. The process of type inserts was used both before and after the period 1507 to 1513, and no one of the St. Dié group suggests that a first or experimental block was made. A map of Europe in the 1513 Ptolemy also has type insets but with different type from that in the Stevens-J. C. B. map. If a specimen block was prepared it was quite as likely this one of Europe.

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[5] Stevens, *op. cit.*, p. xvi. I mention this point as Mr. B. H. Soulsby in the *Geographical Journal* for February, 1902, stated (p. 205) that Mr. Stevens made his findings after years of study: "It was not for some years that he was able to bring his investigations to anything like a satisfactory issue." Mr. Stevens himself (p. 3) says only "many months of patient research."

[6] The copy examined was sold some years ago by Mr. Stevens to Mr. William L. Clements and is in the William L. Clements Library.

[7] This letter and several others of those mentioned below are reproduced in full with translation by John Boyd Thacher in his work, "The Continent of America: Its Discovery and Its Baptism," New York, 1896.

Ptolemaic Studies of the St. Dié Group

In connection with the possible appearance of another map by Waldseemüller in the period 1505 to 1513 the statements made by Waldseemüller, Ringmann, and Lud and their correspondents are far more important than the uncertain Latin of the 1513 editor and a chance statement about a book in preparation. The three men mentioned constitute the St. Dié group involved in the projected publication of Ptolemy. In 1505 Ringmann published a Vespucci tract, including a letter dated August 1, 1505, to Jacob Braun. In it he remarks that the items of the book of "Albericus" (Vespucci) have been compared with Ptolemy "whose maps we are now examining with diligence." However, according to Avezac[8] and to Schmidt,[9] Ringmann did not go to St. Dié until towards the end of 1506 or early in 1507. Even had he been there, this reference indicates only a beginning of study and that in 1505 the name "Albericus," not "America," was in use by this group.

The letter to Amerbach quoted in small part by Stevens is primarily to request the loan for a month of the Greek text of Ptolemy in a manuscript of the Dominicans at Basel in order to correct the text, then obviously not completed. Waldseemüller promises Amerbach a copy of the globe gores ("solidum quod ad generale Ptholomei"), which, he states, are to be completed within a month. Certainly at this time the "Cosmographiae Introductio" was at the printer's, and in all probability the large map of 1507 had then long been under way. This is absolute proof that the Ptolemy was by no means ready for the printer.

Even in 1508 Ringmann was continuing in Italy his study of Ptolemaic manuscripts, as is indicated by a letter, published in the 1513 Ptolemy, written by Mirandola in September of 1508. Wieser[10] presents further evidence that these studies continued in 1508 and 1509. Obviously also the study of the Ptolemaic maps of the Old World preceded the preparation of the map of the New World. The Castle Wolfegg map definitely issued in 1507, the globe, and the Cosmography certainly occupied most of Waldseemüller's time between 1505 and 1507; the Cosmography itself was conceived as a part of the study of Ptolemy.

In the "Cosmographiae Introductio" of 1507 Waldseemüller's references to the map and globe practically preclude the possibility that he had then completed any other map of the world. To the Emperor he states: "I have prepared for the common use of students . . . a figure of the entire earth as well in the form of a globe as a representation on a plane." On the reverse of the geometrical insert in the Cosmography he states: "In constructing the globe we have been very restricted in space. But we have had more room in making our map." This sentence continues with descriptive matter corresponding precisely to the large Wolfegg map of 1507. Had Waldseemüller published any world map in 1505 or 1506, here it would have been necessary to mention the fact.

In the year 1508 Waldseemüller writes a letter to Ringmann, published in the 1508 edition of the "Margarita Philosophica" by Gregorius Reisch, mentioning that at St. Dié "as thou knowest principally by my labor, although many others here and there falsely take the credit of it, we have lately composed, drawn and printed a map of the entire earth, in the form of the globe as well as of a planisphere, which is making its way over the world not without glory and praise." Here again Waldseemüller certainly mentions no other world map where it was essential had one been published by him. This protest of Waldseemüller undoubtedly refers to the

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[8] M. d'Avezac: Martin Hylacomylus Waltzemüller: Ses ouvrages et ses collaborateurs, Paris, 1867.

[9] C. Schmidt: Mathias Ringmann (Philesius) Humaniste Alsacien et Lorrain, *Mémoires Soc. d'Archéologie Lorraine et du Musée Historique Lorrain*, Ser. 3, Vol. 3, Nancy, 1875, pp. 165–233; reference on p. 193.

[10] F. R. von Wieser: Die Grammatica Figurata des Mathias Ringmann (Philesius Vogesigena) in Faksimiledruck herausgegeben mit einer Einleitung (Drucke und Holzschnitte des XV. und XVI. Jahrhunderts, Vol. 11), Strasbourg, 1905, p. 12. See also Schmidt, *op. cit.*, p. 201.

fact that the Cosmography was issued during his absence with the name of the Academy substituted for his in the dedication to the Emperor. It may also be a protest against a statement by Walter Lud in his "Speculi Orbis . . . Declaratio" of 1507 in which Lud takes credit for having prepared a map of the new world. Lud refers to a hurriedly prepared map and adds that further details will appear in the Ptolemy. Mr. Stevens assumes that this cannot refer to the Wolfegg map of 1507, but equally it cannot refer to the map in the 1513 Ptolemy nor to its alleged prototype.

In the year 1511 Ringmann published at Strasbourg the "Instructio Manuductionum Praestans in Cartam Itinerarium Martini Hilacomili . . . " and Waldseemüller himself writes the dedication to Duke Anthony, noting therein that the Duke's father had graciously accepted from Waldseemüller a map of the world ("generalem orbis descriptionem"), undoubtedly the large Wolfegg map of 1507, and further refers to the continuance of other cartographical labors, "quaedam id generis jam inchoata." This would certainly seem to refer to further work on the maps of Ptolemy.

In the same work Ringmann publishes a letter addressed to Waldseemüller in which he says: "You have won, Martin, the esteem of many studious people in having formerly published a general map of the entire world, very artistically made, and in having devoted yourself for so long a time to drawing the Ptolemaic maps."[11] Here the large world map is given definite place in preparation ahead of the Ptolemaic maps. Had a second map of the world been published, Ringmann should have mentioned it.

After the appearance in 1507 of the Cosmography with the globe and the large map of 1507 Glareanus and Stobnicza, prominent European geographers, adopted the delineations of the New World there suggested. No map is known which shows use of the Stevens-J. C. B. map before 1513, nor of the "Orbis Typus" in the Ptolemy of 1513 which is, of course, geographically the same. The maps of the 1513 Ptolemy became of importance after that date, appearing again from the same block in the Ptolemy of 1520. In 1522 Laurentius Fries republished the maps in smaller size, and these maps appeared in further editions of Ptolemy in 1525, 1535, and 1541.

As the geographical outlines of the Stevens-J. C. B. map were used from 1513 to 1541 in the editions of the geography of Ptolemy, it is evident that at any time in this interval such a map as the Stevens-J. C. B. map could have been prepared without doing violence to then current geographical ideas. As the map itself was found in a 1513 Ptolemy, it was probably made after 1513 and inserted by some one who regarded it as a later map because it had the name America.

Argument from the Geographical Configurations

The geographical configurations of the Stevens-J. C. B. map—which are, as stated above, identical with those published in the "Orbis Typus" of the 1513 Ptolemy—should enable us to determine the approximate year of the composition. For this purpose a comparison with the Wolfegg map of 1507 and the dated "Charta Marina" of 1516 is desirable. The 1507 map is geographically a crude map, following largely Ptolemaic tradition. In particular the following points should be noted: Scotland bears a curious protruding extension to the East; Italy has a strange curve downwards at the heel; the Indian peninsula is practically nonexistent; the island of Ceylon (Taprobana) is enormous; the Red Sea runs almost straight north and south; the northern coast of Africa slopes from northwest to southeast.

Each one of these peculiarities is found in the 1490 Ptolemy published in Rome. Each one of these peculiarities is found twice (small hemispheres are placed at the top of the large map) in the Castle Wolfegg Waldseemüller map of 1507 and again

[11] Translation of Thacher, *op. cit.*, p. 155. The complete Latin text is given there.

in the 1507 (or 1509) globe gores by Waldseemüller. Each one of these peculiarities is corrected in the "Charta Marina" of 1516. Each one is corrected, not always as completely, in the Stevens-J. C. B. and the 1513 Ptolemy "Orbis Typus."

An additional peculiarity is found in the 1507 Wolfegg map in that Africa terminates in a broad bulging tip extending south to about latitude 53° S., whereas in the 1516 map the tip is narrow and tapering and extends only to 31° S. The bulging tip extending to 50° S. is found in the Bernard Sylvanus Ptolemy of 1511, with other of the above-mentioned peculiarities corrected; whereas the 1508 Ruysch map, issued in 1508 with the Ptolemy published at Rome, has the bulging tip with another series of corrections. The bulging Africa is found on a small globe depicted on the title page of the "Globus Mundi" published at Strasbourg in 1509.

The first printed delineation of the Portuguese discoveries in Africa is given by Nordenskiöld (Facsimile Atlas, p. 62) as in the "Itinerarium Portugallensium" published at Milan in 1508. This small map has Africa with the shorter tapering tip, Italy corrected, and the Red Sea at an angle. This is a small and crude map with no indication of latitudes.

In every one of these points mentioned the Stevens-J. C. B. map marks a step in the progress from the crude geographical effort of 1507, obviously a maiden effort based on Ptolemy and the 1516 "Charta Marina." It is inconceivable that a scholar of the ability of Waldseemüller should have made in 1506 a map as correct as the Stevens-J. C. B. map and then in 1507 have gone back to the absurdities of the old Ptolemaic geography.

It may be mentioned in passing that the Wolfegg map of 1507 is on a peculiar and somewhat difficult projection. The map must have taken months of work, and it includes as an ornament in the top center two hemispheres upon a different projection. The globe gores constitute still a third type of projection of the world map used by Waldseemüller in 1507. The 1516 and the 1513 "Orbis Typus" (or Stevens-J. C. B.) are upon yet a fourth type, in which further a space of about sixty degrees is left blank. The first three and the Cosmography were a tremendous achievement for the young cartographer to have accomplished by April of 1507.

It is true that Portuguese manuscript maps were in circulation before 1507 that corrected many of the Ptolemaic peculiarities and gave also a correct delineation to the tip of Africa. However, the cartographers and cosmographers of that day were not willing to accept and print these maps. Glareanus, Stobnicza, Apianus, and Schoener made use of the Wolfegg map of 1507, retaining almost entirely the peculiarities mentioned.

There is no intention in this article of casting any discredit upon the account given by Mr. Stevens. However, in historical matters documents that are as definitely dated as the Castle Wolfegg Waldseemüller map of 1507 and the Contarini map of 1506 at the British Museum are rightly accorded an authority that cannot be given to some document whose dating involves elaborately spun theories. The accidental placing of the name America by some unknown printer upon a map current from 1513 to 1541 has little significance either in the history of American cartography or the history of the naming of America. The majestic map issued with certainty in 1507 began a new period in cartography of the New World and placed the name America definitely upon the map of the world.

AMERICAN GEOGRAPHICAL SOCIETY

Presentation of the Cullum Geographical Medal to Jean Brunhes and of the Charles P. Daly Medal to Émile Félix Gautier. Presentation of the Cullum Geographical Medal to Jean Brunhes and of the Charles P. Daly Medal to Émile Félix Gautier took place at the American Embassy in Paris on May 14 in the presence of M. Charlety, Rector of the University of Paris, M. Bedier, Administrator of the Collège de France, and a distinguished company of French and American savants. Presentation of the medals was made by His Excellency the American Ambassador, Walter E. Edge, who spoke as follows:

"By direction of my Government and on behalf of the American Geographical Society, I have the honor and privilege of presenting the Society's gold awards for 1929 to you, Professor Brunhes and to you Professor Gautier, in recognition of your distinguished rôles in the advancement of universal science.

"For many years your eminent services have contributed to the advancement of scientific knowledge in your own country and in mine, thus proving conclusively once again that science knows no boundaries and that in the best sense of the word it is not national but international.

"Your work, Professor Brunhes, has had a profound influence on the teaching of geography in the United States and on the development of our point of view in the geographic field. Through translated editions of your many and valuable publications we as well as our friends here in France have reason to appreciate why, in the world of culture and practical endeavor, your name stands foremost.

"You, Professor Gautier, are cited for the Charles P. Daly Medal of the American Geographical Society in recognition of your conspicuous services in investigating the geography of North Africa and the Sahara. It is peculiarly fitting that your brothers in science in my country should select this moment when your country is celebrating the centenary of its North African interest to recognize you whose name is in the scientific field so indelibly associated with that great and important achievement.

"Gentlemen, I beg you to accept these medals as ever-present tokens of my country's appreciation of your work and as immutable evidence of the mutually complementary obligations of cultural life on our two nations."

A brief response on behalf of his colleagues was made by Rector Charlety.

Presentation of the Cullum Geographical Medal to Hugh Robert Mill. The Cullum Geographical Medal, awarded to Dr. Hugh Robert Mill for his services to geography (see *Geographical Review*, Vol. 20, 1930, p. 313), was presented at the meeting of the Royal Geographical Society held on May 19. Presentation was made by His Excellency the American Ambassador, General Dawes, who spoke as follows:

"As the representative and at the request of the American Geographical Society, I have the honor to present to you the Cullum Geographical Medal of that organization, as a recognition of your researches and writings for the advancement of geography.

"The American Geographical Society recognizes your outstanding contribution to that science. They feel that your researches, so largely directed toward the discovery of the control exerted by the various forms of the earth's solid crust upon the fluid envelopes, and your other varied labors, have always rested on a sound physical basis. They recognize, too, that educational geography has profited greatly from your writings.

"The duty allotted to me is a most pleasant one. Since the giver of this token is the American Geographical Society and the recipient a member of the Royal Geographical Society of Great Britain, this occasion is partly Anglo-American. But it is more than that. The commonwealth of science recognizes no boundary lines. Distinction won in it has a world rather than a national significance, and he who achieves it has his highest reward in the admiration and the gratitude of all peoples, of which this medal, although coming from the American Geographical Society, may well be regarded as a symbol."

In replying, Dr. Mill said:

"I thank Your Excellency and desire to thank also the American Geographical Society of New York for this more than generous recognition of the little I have been able to do for geography. The design of the Cullum Medal—Discovery looking forward at the prow of a speeding boat—appeals to me powerfully, for my life has been spent in searching out the ways of many waters.

"How often has this Medal been awarded to men whose names are eternally linked with the ships that bore them to fame—Peary and the *Roosevelt*, Nansen and the *Fram*, Murray and the *Challenger*, Scott and the *Discovery*, Shackleton and the *Nimrod*, Bruce and the *Scotia*, Charcot and the *Pourquoi Pas?*, Albert, Prince of Monaco, and the *Hirondelle*—all men whose names shine in many temples of fame, all capital ships whose global and categorical significance no conference of the powers however protracted could ever agree to diminish. Nor can I forget the other great geographers, your compatriots, chief among them William Morris Davis, whose remorseless New England logic forced our minds to grapple with the hard basal facts of physical geography, and Ellen Churchill Semple, who has invested with her Southern grace and charm the subtle influence by which the land guides the grouping of peoples and the history of nations. I should almost feel myself an intruder in such an august assembly, considerate colleagues as all of them have been to me, had not your goodness already admitted there Keltie and Reeves, my old comrades on the staff of this Society.

"The Cullum Medal has for me a meaning that goes deeper than the expression of approval, by a scientific institution, of the willing workers in its cause. It was not awarded for three years, so that in the fourth the Society could show the breadth of its international sympathy by giving it simultaneously to Brunhes in France, Hettner in Germany, and Schokalsky in Russia, to whom I am proud to be a fourth. The presentation by Ambassadors to geographers beyond the confines of the United States carries with it the good will of a great nation towards the people of all the world; and a large element in the gratification with which this honor envelops me is that it comes from the hands of one who has worked so long and achieved so much as Your Excellency in the cause of the brotherhood of mankind."

Presentation of the Cullum Geographical Medal to Alfred Hettner. The Cullum Geographical Medal was presented to Dr. Alfred Hettner at Heidelberg on June 2. The presentation was made by His Excellency the American Ambassador Frederic M. Sackett at a ceremony held in the office of the Rector of the University, Dr. Gotschlich, and was attended by the authorities and members of the faculty of the University and a number of scientific friends of the institution. The Ambassador, introduced by Dr. Gotschlich, spoke in part as follows:

"I have come to Heidelberg today commissioned by the American Geographical Society to present a token of appreciation to an illustrious scholar for distinguished service rendered by him in one of the most important fields of science.

"Two of your great countrymen—Georg von Neumayer, physical geographer, hydrographer, and meteorologist, and Hermann Wagner, geographer and statistician—have already been awarded this [Cullum Geographical] medal of the American Geographical Society. Geheimrat Doctor Hettner, who takes his place with them

as one of the distinguished scientists of the world, has exercised great influence on the development of scientific geography, particularly of regional geography, of which he is probably now the leading German exponent. He is founder and editor of the *Geographische Zeitschrift* since its inception in 1895, the leading critical German periodical and one of the foremost critical geographical journals of the world. He has made important researches and written numerous books that have been accorded international recognition; he has traveled extensively, particularly on the South American continent, in the interests of his chosen field. He has taught scientific geography for nearly half a century, having been professor at the University of Leipzig, at Tübingen, and for thirty years at Heidelberg. Truly it can be said that he has distinguished himself in the advancement of geographical knowledge.

"May I express the hope that the recognition of these distinguished abilities by the American Geographical Society may serve to bring into closer relationship those German and American minds which have been devoting themselves so unselfishly to the progress of our civilization in every branch of intellectual development. The recognition of an outstanding personality of the Old World is a privilege for a society devoting itself to the development of scientific achievement in the New World and serves to strengthen the tie that binds.

"Doctor Hettner, it not only is a great pleasure, but an honor, to be the representative of the American Geographical Society and to deliver to you in the presence of your learned colleagues the Cullum Geographical Medal in sincere appreciation of your contribution to science."

In response, Dr. Hettner thanked Ambassador Sackett for his kindness in coming to Heidelberg to make the presentation and begged him to convey thanks to the American Geographical Society for the honor it had done him and, in his person, to German geography at large. He spoke with appreciation of the simultaneous award of the Cullum Medal to scholars of other countries, a happy sign that in geographical science the barriers raised by the war had been broken down. Referring to his countrymen Georg von Neumayer and Hermann Wagner, previous recipients of the Cullum Medal, he spoke of his own long connection with geography, his special study "from the very beginning." "Perhaps because I entered geography while young, perhaps from a natural inclination I have always concerned myself most particularly with the question of methods in our science, to the end that my experience has found expression in an interpretation of the modern ideas on the subject."

From a brief mention of the part German science has played in the development of geography Dr. Hettner turned to the United States. "I shall not speak here of the work of the universities and geographical societies and their publications," he said, "nor of American exploring expeditions to foreign lands. I will mention two things only through which American geography has exerted special influence, particularly in Germany.

"One is the pioneer exploration of the West, from which it may be said physiography as a science has arisen. While the nature of the land was favorable, the decisive factor was the happy plan of work, the combination of topographical surveys with geological and physiographic research. Men like Hayden, Whitney, Powell, Gilbert, to name only a few, rank for this reason among the important geographers of the second half of last century.

"The other influence lies in the field of the geography of man. Ratzel, who by some is considered the founder of human geography, went to America as a journalist trained in natural science and returned home a thoroughgoing geographer. In the spaciousness of his concepts is unmistakably reflected the influence of the broad expanses of the North American continent. And he in turn exerted an influence on American geography. Miss Ellen Churchill Semple made an excellent free translation of his "Anthropogeographie" and thus developed further the stimulating pioneer work in this field of Nathaniel Southgate Shaler.

"American and German geography work together in perfect accord. I rejoice in the expression of the accord in this presentation, and I repeat my thanks to the American Geographical Society and to the Ambassador who has conveyed to me this distinction in so gracious a manner."

Recent Publications

The Millionth Map of Hispanic America. The Society announces the publication of ten new sheets of this series. They include two on the lower Amazon River in the vicinity of Manáos (South A-20, *Manáos*, and South A-21, *Santarem*), two sheets covering Dutch Guiana and the greater part of British Guiana (North A-21, *Alto Trombetas*, and North B-21, *Georgetown*), two sheets on the upper Madeira River and its tributaries (South C-20, *Rio Madeira*, and South D-20, *Rio Guaporé*), two adjoining sheets in southern Chile (South J-18, *Concepción*, and South K-18, *Isla Chiloë*), and the two sheets adjacent to these last on the east covering mainly Argentine territory (South J-19, *Parral-Neuquén*, and South K-19, *Lago Nahuel-Huapi*).

In addition to these ten sheets seventeen others are now at the lithographers, making, with the twenty sheets previously published, a total of forty-seven sheets on which the work of the Society has been completed. These forty-seven sheets include, in addition to several isolated sheets, all of the Amazon Basin, all of Bolivia, all of Chile with the exception of the Santiago sheet (South I-19), all of Patagonia, the Guianas, and five sheets in the West Indies.

Star Lists. For the past six years members of the staff of the Society's School of Surveying have been engaged on the computation of lists of stars for use with the prismatic astrolabe or the Reeves prism attachment for theodolites in connection with the equal-altitude method of determining latitude and longitude. Lists for each degree of latitude from 60° North to 60° South, including all the stars for which ten-day places are given for the year 1930 in the American *Ephemeris*, the British *Nautical Almanac*, and the French *Connaissance des Temps*, have been computed and have now been published in a volume of 440 pages of which 389 pages are devoted to the actual lists and the remainder to notes on the lists and the methods by which they were compiled, a section of "Suggestions for the Adjustments and Use of Reeves's Prism Attachment for Theodolites," notes on watches and radio equipment for receiving time signals, and examples of recording and computation forms designed by the School of Surveying for use with the equal-altitude method and the computation and graphic plotting of results. The lists include approximate local times and azimuths of crossing the altitude of 60°, magnitudes, names, and approximate right ascensions of the stars listed.

The preparation of these star lists was undertaken as a part of the program of research which is being carried on at the School of Surveying with the object of simplifying the equipment and work of surveyors in the field. The first lists were compiled in 1923, when Mr. Weld Arnold and Mr. O. M. Miller each prepared a list for one degree of latitude for the Rice expedition to the Rio Branco. Mr. Miller continued the computing of the lists for some time and devised the system of graphs and cards used throughout the work. The lists for each degree of latitude were originally issued in photostat form as completed. In 1927 Mr. Arnold undertook the completion of the set of lists from 60° North to 60° South, arranged for their publication in book form, and prepared the accompanying text. Miss Dorothy F. Mayhew, secretary of the School of Surveying, in addition to editorial work devised a method of checking which not only greatly minimized the possibility of errors in the published lists but shortened by months the whole task.

The volume is dedicated to Dr. Alexander Hamilton Rice whose generosity made possible the compilation and publication of the work.

GEOGRAPHICAL RECORD

NORTH AMERICA

A Stone Culture from Northern Labrador and Its Relation to the Eskimo-like Cultures of the Northeast. Under this title William Duncan Strong discusses a number of artifacts secured between Hopedale and Nain in the course of archeological reconnaissance as a member of the Rawson-MacMillan Subarctic Expedition of the Field Museum in 1927–1928 (*American Anthropologist*, Vol. 32, 1930, pp. 126–144). Because of the similarity of the stone-working technique to that of the Eskimo he was at first inclined to attribute the artifacts to an earlier branch of that people; but, after a wider study of the archeological problems involved, he became "convinced that in this old stone age culture of northeastern Labrador we have traces of an earlier Indian population which preceded both the Eskimo and the Naskapi in the region." Certain other isolated finds in the area, however, he thinks, "suggest that an older Eskimo culture may yet be distinguished in northeastern Labrador that will bridge the wide gap between the old stone culture and the later bone and steatite-working Eskimo culture."

Since this was written, the reviewer discovered on the west coast of Newfoundland evidences of the presence of an Eskimo people with a culture similar to that of the Cape Dorset culture, described in this *Review* by Mr. D. Jenness, a few years ago. A few artifacts, probably left by the same people, were also discovered at Bradore, at the eastern end of the Canadian Labrador. It is probable, in view of these more recent discoveries, that the Eskimo-like artifacts from Strong's old stone age sites were left by people of this old Eskimo culture and that the artifacts of Indian origin, especially the stone gouge, had been left by later Algonkian inhabitants of the same sites, who entered the country after the Eskimo withdrew toward the north.

W. J. WINTEMBERG

Land Classification in the Northern Great Plains. The first extended regional attempt at land classification completed under the auspices of the Land Classification Board of the United States Geological Survey appropriately deals with the Northern and Central Great Plains. Mimeographed reports with printed maps dealing with the Central Great Plains (Parts 1 and 2, Western Kansas and Nebraska, and Part 3, Southeastern Wyoming) were issued in 1928 and 1929. Late in 1929 the report on the Northern Great Plains appeared. It is a mimeographed report of 136 pages accompanied by eight printed maps (1 : 500,000), which cover nearly 130,000,000 acres in the western halves of South Dakota and North Dakota and eastern Montana and Wyoming. They show nine types of surface by color: farming land, farming-grazing land, grazing-forage land, grazing land, irrigated land, Missouri River bottom land, not irrigated, nontillable grazing land, national forests, and water surface. The compilation of the data shown on the maps or given in the report was under the direction of A. E. Aldous and J. F. Deeds. The report summarizes very briefly by states and in more detail by counties the data shown on the maps, giving the percentage of each type of land and the local characteristics and other relevant data. Report and maps are an outgrowth of the requirement of the Stock Raising Homestead Act of 1917 which provided that, of public land officially designated primarily as grazing land, the homestead unit can be 640 acres.

One of the important conditions disclosed by the report is the amount of farming now done in the area recently considered suitable only for grazing, and the extent of

additional land as well suited for farming as is the land now farmed. Some 16,000,000 acres of land was farmed in 1924, but less than half of the land classed as farm land in most counties was farmed. Of the 130,000,000 acres classified, there were slightly over 16,000,000 acres each of farming, farming-grazing, and grazing-forage land. Of grazing land there are 70,000,000 acres, of national forest reserve 9,000,000 acres, and of irrigable or river bottom land 2,700,000 acres.

The cheapness of the land in the Northern Great Plains, the friable soil and gentle slopes on the better land, and the large fields all favor the use of tractors and other labor-saving machinery. Crops can therefore be put in cheaply. When the rainfall is opportune, the yield from the fertile soil is large enough to offset a number of years of small yields. In most of the counties of the area classified the yield of wheat on the better land averaged for the six years 1919–1924 approximately the United States average (14.7 bushels). Wheat occupied 45 per cent of the cropped land in North Dakota in 1924 but only 10 per cent in South Dakota, where corn is the chief crop. The average yield of corn in western South Dakota is little below the average for the United States. Even in North Dakota the average yield is twenty bushels per acre, and the growing of corn in the Great Plains section of the state has increased rapidly in recent years.

The southeastern part of the Northern Great Plains experienced a doubling of the land in cultivation between 1919 and 1924. Montana, after a severe slump that followed the dry years of 1917–1919, has shown a sharp recovery. North Dakota has, however, most land classed as non-irrigable farming land in this report—9,100,000 acres of the 16,200,000 acres: Wyoming has none, South Dakota 2,800,000 acres, and Montana 4,300,000 acres.

S. S. VISHER

EUROPE

A New Estimate of the Population of Britain in Roman Times. A significant discussion of the population of Roman Britain has been recently provoked by the publication of the remarkable "Map of Roman Britain" issued by the Ordnance Survey. The new edition of the map (1928) has improved in many respects on the earlier edition (1924). The southern part of the Scottish highlands is now included; new gradations of the contours are distinguished in the color scale; the dense and open woodlands have been indicated, on the basis of geological evidence; and the various types of settlement are marked. Several classes of fortified places are distinguished and towns, villages, and villas. Roads, mines, and potteries are indicated. Mr. R. G. Collingwood felt that this map constitutes a basis for a substantial reconstruction of many elements of Roman life and proceeded to a study of population and settlement that confirms the views of an important group of scholars (Town and Country in Roman Britain, *Antiquity*, Vol. 3, 1929, pp. 261–276). As the figure suggested for the population of Roman Britain is lower than any given hitherto, it is hardly surprising that it has been challenged (H. J. Randall: Population and Agriculture in Roman Britain: A Reply, *ibid.*, Vol. 4, 1930, pp. 80–90; R. E. M. Wheeler: Mr. Collingwood and Mr. Randall: A Note, *ibid.*, pp. 91–95). The application of the new low figure to the discussion of agriculture likewise arouses opposition and incredulity.

There are various infelicities of expression in Mr. Collingwood's essay, but if the paper is studied with the Ordnance Survey map at hand it is an impressive contribution to the interpretation of the economic life of Roman Britain. As the late Mr. Haverfield said: "Romano-British life was on a small scale. It was, I think normal in quality and indeed not very dissimilar from that in many parts of Gaul. But it was, in any case, defective in quantity." Mr. Collingwood furnishes us with a more precise statement of the scale of life in this Roman province. Apart from London, there were four colonies, thirteen tribal capitals, and three or four other

towns of equivalent importance; in all, about 20 towns outside of London, estimated at 5000 persons each. London is rated at 25,000. Road junctions and posting stations account for small towns, figured at a total of 75 and rated at 1000 persons each. Seven hundred villages are marked on the map, and the possible total is presumed not to exceed 1500 when allowance is made for omissions. These villages are rated at 100 persons each. About 500 villas are marked on the map; and, though there is no ground to assume large omissions, the total is set at 1000, and they are rated at 50 persons each—a much larger number than could have been accommodated in the smaller villas. These estimates yield a total civil population of 400,000, to which must be added 100,000 for the army and its dependents. The count from the map, with every reasonable allowance for omissions and very generous ratings for the various units of settlement, thus yields a figure of about 500,000 for the total population.

Mr. Randall discusses only this figure, though Mr. Collingwood points out two other possible figures. By distribution of totals for the Empire as a whole, he concludes that the population of Britain must lie between 500,000 and 1,000,000. By projecting backward the growth ratios of the early middle ages, a figure below 750,000 would be indicated. As the map seems to afford the most tangible basis for an estimate, Mr. Collingwood concludes that the map estimate is the nearest approximation we can now make towards the population of Britain.

To persons deeply impressed with the quality of Roman civilization such an estimate seems incredible. Edward A. Foord gave characteristic expression to this older view in estimating the total population south of Hadrian's Wall at from 3,000,000 to 3,500,000 (The Last Age of Roman Britain, p. 66). Mr. Wheeler is not quite so optimistic; but in commenting on Mr. Collingwood's paper he computes the population capable of supporting the "economic burden" of life in Roman Britain at a total of 1,500,000 persons. He adds, however, in a spirit of generosity: "When all is said and done, the difference is but trivial."

The issue, however, is far from being trivial. We have grounds to suppose that various sections of the Near East did experience considerable vicissitudes in respect of their population. Reaching high densities at certain stages, their population did in fact decline to as little as one-half the former total. But in northwest Europe we have no evidence of similar vicissitudes, and there are strong grounds to presume that we must think of these sections rather as frontiers in the process of settlement, disclosing more continuity in the growth of population (compare the reviewer's paper "The History of Population and Settlement in Eurasia," *Geogr. Rev.*, Vol. 20, 1930, pp. 110–132).

Mr. Collingwood deserves great credit for perceiving the full significance of this notable map contributed by the Ordnance Survey. It is an objective record of a palpably frontier settlement. Forest and fen were untouched, and even the thinner woodland was scarcely occupied at all. Villages and villas appear primarily in the open fields of the uplands, though the higher open ground of valley and shore is also utilized. The distribution of settlement was thus closely similar to what is considered typical of pre-Roman Britain and presents a considerable contrast to what we know of the patterns of settlement at the end of the Saxon period and at the time of the Domesday Survey. The distribution of known areas of settlement, too, has a quantitative significance that seems to have escaped Mr. Randall and Mr. Wheeler. In 1086 the area of significant settlement was very much larger; the eastern countries and northerly midlands, which were scarcely occupied in the Roman period, possessed a substantial population. Neither Wales nor the countries of the northern border figure significantly in the picture at either date. An appeal to the presumptions created by the supposed "economic burden" of life can carry no weight to offset the objective significance of the narrow limitations of the area of actual settlement in Roman Britain.

Mr. Collingwood was criticized by Mr. Randall for computing a density figure for the entire area of England and Wales, and in view of the uneven distribution of population the point is well taken. Mr. Collingwood's thesis is not, however, affected by any probable allocation of the population between the two areas that were significantly settled. The northern border counties and Lancaster, Chester, Durham, and Cornwall were merely an area of military occupation. Wales had a small civil population but so little that it can hardly justify the attempt to state a density figure for the areas as a whole. There was, however, a measurable civil population in the following counties: York, Lincoln, Notts, Derby, Stafford, Salop, Hereford, Worcester, and Warwick. With modern boundaries this area amounts to 15,584 square miles. The counties to the south and east with the exception of Cornwall, already noted, constitute the area of primary settlement. The eastern counties were, indeed, more thinly settled than the open lands in the southwest, but we can hardly discriminate. With modern boundaries this area comprises 25,687 square miles. If we now presume a ratio of 1 to 5 in the total population of these areas, we have densities of respectively 5 and 13 persons to the square mile, if we allot 12,500 of the military population to the less densely settled civil area and divide the civil population of 400,000 between the two areas. If we assume a ratio of 1 to 3 in the total population of these areas, the densities per square mile would be 9.4 and 10.4. Therefore, even if we assume a very small total population in the less densely settled civil area, the density of population in the south is still very low. Mr. Collingwood's estimates could be increased sensibly without affording any basis for supposing a density of 20 persons to the square mile in the southerly counties.

Under these circumstances there are strong grounds for accepting Mr. Collingwood's presumption that the agricultural methods were relatively extensive. The relatively low density of population and the actual distribution of settlements in the open ground would not afford much support for a theory of drastic romanization of agrarian life or agricultural methods. It is obviously dangerous to draw inferences from the map in this respect, though there is clearly justification for Mr. Collingwood's insistence upon the importance of the clearing of forests by the Teutons and their skill in plowing the heavier soils. The nature of the Teutonic migrations is closely associated with the presumptions entertained of the population at the various dates. Those who assume a large population in Roman Britain must needs picture a series of "invasions" that were terribly destructive of life. This notion of the migrations becomes less tenable if it is recognized that we really have no evidence of the existence of any such mass of population in Roman Britain as is assumed by Foord or even of the more modest population estimated by Wheeler. We have every reason to believe that Mr. Collingwood's reading of this new map brings us closer to the actual life of Roman Britain than his critics are as yet prepared to admit.

ABBOTT PAYSON USHER

The History of Vesuvius in Pictures and Maps. What Vesuvius looked like before the great eruption of 79 A.D., in which Pliny the Elder lost his life, has been the subject of controversy among scholars. G. B. Alfano and Immanuel Friedlaender ("Die Geschichte des Vesuv: Illustriert nach gleichzeitigen Urkunden," Dietrich Reimer (E. Vohsen), Berlin, 1929) believe that the present cone did not then exist and that the Vesuvius of Strabo and the Latin writers was the Monte Somma of today. This contention is apparently borne out by a wall painting from Pompeii now in the Naples Museum and, possibly, by a lost painting from Herculaneum of which an eighteenth-century reproduction exists.

From the beginning of the sixteenth century onward many pictures and maps of Vesuvius have been preserved. Together with descriptions of the eruptions, these enable the student to reconstruct in some measure the history of the volcano and of its ever-changing form. In the text of Alfano and Friedlaender's book this record

is outlined, and many bibliographical references are given. The book, however, is essentially a collection of illustrations, many of which are extremely impressive. Some, in color, show the volcano by night with the lurid glow from the molten lava. Others, painted by day, reveal the dark and looming cauliflower or "pine tree" ash clouds, the white columns of steam, and the lightning flashes that accompany every great eruption. The successive furls of the ash clouds made by the rhythmic sequence of gas explosions are expressively drawn. While it is hard to believe that some of the pictures are not exaggerated, the authors assure us that they have included none that are purely fantastic and none not made by eyewitnesses. No photograph reflects the awe-inspiring beauty of a great volcano as do these quaint views.

The book is accompanied by an excellent colored map of Vesuvius as of 1927, scale 1 : 25,000. Here brown streaks and splotches show the lava flows of different dates spreading down through the green woods and gardens of the mountain side and menacing the villages at its base. It is notable that all the flows lie to south and west of a line drawn nearly west-northwest and east-southeast through the crater. The areas north and east of this line are protected by the semicircular ridge of Monte Somma. But, though spared from lava, these regions during severe eruptions are frequently bombarded by ejecta and are buried under ashes. In 1906 Ottajano and other towns northeast of Vesuvius suffered cruelly, even though the wind was apparently blowing *from* their direction.

In 1905 the maximum height of Vesuvius was 1335 meters. The terrific eruption of the following year reduced this by about 150 meters, and at the end of 1927 the altitude was only 1130. The eruption of 1906 also cleared out the crater to a depth of about 700 meters. Since then landslides from the walls and successive upwellings of lava have gradually filled in the crater. The stage reached by 1920 was illustrated in a note and cross section in the *Geographical Review* for 1924, page 309. In the autumn of 1926 the level of the lava platform reached the lowest point in the crater rim (on the northeast), and the molten flood poured into the Valle dell' Inferno between Monte Somma and the main cone. Further outpourings into the Valle dell' Inferno occurred during 1927 and 1928 (*Zeitschr. für Vulkanologie*, Vol. 12, 1929, pp. 47–52). A severe eruption took place on June 3–7, 1929. The secondary cone, which since 1913 had been growing within the crater, was partially shattered. A molten river made its way down into the Valle dell' Inferno, whence it found two outlets to the east and southeast. One stream followed the course of flows of 1834 and 1906 and did no damage, but the other swept down to the outskirts of Terzigno, where it destroyed one village and parts of two others.

In describing the eruption of 1929, A. Rittman (*Die Naturwiss.*, Vol. 17, 1929, pp. 795–802) observes that in general the advance of a lava stream is sufficiently slow to permit the evacuation from the threatened areas not only of the population but of movable property. When, as at Campetiello, the molten lava covers a spring, explosions of steam may throw stones hundreds of meters in every direction. "Trees close to a lava flow on the windward side may escape injury, while the foliage for a long distance to the leeward is completely scorched."

AFRICA

New Studies of the Faiyûm Area. The past year has seen the appearance of several important studies embodying the results of research conducted in the Faiyûm. Miss Gertrude Caton-Thompson and Miss E. W. Gardner, in an article entitled "Recent Work on the Problem of Lake Moeris" (*Geogr. Journ.*, Vol. 73, 1929, pp. 20–60), set forth some very significant conclusions based upon geological and archeological observations made on the northern side of the Birket Qarûn. They identified a Faiyûm lake dating from the Middle Paleolithic period, with its highest level at 131 feet above sea level. This Paleolithic lake subsided to 75 feet, at which level it

remained for a considerable time while the Idwa bank formed along its southern shore. There followed, they state, a period of desiccation and erosion, when there was no contact with the Nile, the lake dried up, and the basin was eroded to its maximum depth (*c.* −165 ft.). This depression was subsequently filled by a new lake which had attained its maximum of 59 feet above sea level before the arrival of Neolithic peoples (*c.* 6000 B.C.). This second lake in turn receded with one long pause at 33 feet, and another at −7 feet. It was at this latter stage during the Old Kingdom. Since then there has been a steady shrinkage, and no rise, down to the present residual Birket Qarûn at −147 feet, which is the remnant of the Neolithic lake. Sixteen miles of Ptolemaic irrigation works at 20 to 26 feet were discovered, and a reservoir of the time of Ptolemy II Philadelphus at −15 feet. These new discoveries effectively dispose of the tradition of a Lake Moeris filling the whole depression in the time of Herodotus and of the drying up of this vast body of water by the early Ptolemies. The lowest Ptolemaic settlement was at −132 feet, and the lake had receded to below this point in the third century before the Christian era.

Messrs. K. S. Sandford and W. J. Arkell have published the results of their investigation into the origin of the Faiyûm depression in "Paleolithic Man and the Nile-Faiyum Divide: A Study of the Region during Pliocene and Pleistocene Times" (Univ. of Chicago, Oriental Inst. Publs., Vol. 10: Prehistoric Survey of Egypt and Western Asia, Vol. 1, Chicago, 1929). Linking up their observations in the Faiyûm with others made in the Nile Valley they present the following view.

At the close of the Pliocene the Faiyûm depression as such was not yet in existence, but the region formed part of the Libyan plateau and drained into the Nile. In the Pleistocene a great lake came into being in the Faiyûm, at least as early as Mousterian times. In the Middle and Late Paleolithic this lake contracted from its high level of 112 feet with marked pauses at 92 feet and 74 feet, a series of ten beaches indicating the gradual shrinkage. This lake is the same as the 131-foot lake recognized by Misses Caton-Thompson and Gardner, who, it is stated, have mistaken the 131-foot storm beach for the normal level and have overlooked the 92-foot pause.

Very important is Sandford and Arkell's observation of a Mousterian terrace in the Hawara Channel, which shows a flow from the Nile, then at 118 feet, into the Faiyûm lake. From this it follows that the lake was no longer maintained by local rainfall in the Faiyûm basin. The authors accept the view expressed above that the Paleolithic lake receded from a 74-foot level until it dried up and was followed after a long interval by a Neolithic 57-foot lake. In this interval they, too, place the erosion of the depression to its maximum depth. But they disagree with Misses Caton-Thompson and Gardner as to the method of erosion, saying that this was due to the action of water which drained out of the Faiyûm in reverse direction through the Hawara Channel, lowering this channel to meet the now lowering Nile bed. Pluvial conditions still prevailed throughout the region, and a desert climate had not yet set in. The Neolithic lake was produced by the Nile aggrading its bed and again reversing the flow through the Hawara Channel, thus causing the depression to be filled to 57 feet and fresh deposits of Nile silt to be laid down to its floor.

The Sandford-Arkell view (as expressed in *Nature*, No. 3052, Vol. 121, 1928, April 28, p. 670; and in *Man*, April, 1929, pp. 66–69) has been attacked vigorously by Miss Gardner in "The Origin of the Faiyum Depression: A Critical Commentary on a New View of Its Origin" (*Geogr. Journ.*, Vol. 74, 1929, pp. 371–383). Her main criticisms are the following: (1) The 74-foot lake level is Mousterian or Middle Paleolithic, not Late Paleolithic as stated by Sandford and Arkell. (2) The sheltered north shore of the lake gives a truer idea of the several levels than the exposed south shore. The ten beaches observed on the latter between 102 and 71 feet may be storm beaches and need not cover any long period of time. (3) The time interval between the close of the Paleolithic and the beginning of the Neolithic Age is too short for the changes assigned to it by Sandford and Arkell. (4) Instead of the heavy con-

tinuous rainfall necessary for the excavation of the Faiyûm low levels by a Nile tributary, this interval was one of dry periods alternating with times of heavy precipitation. Hence wind erosion was the more important factor.

The article of Georges Hug, "Aperçu d'ensemble sur la géographie physique du Fayoûm" (*Bull. Soc. Royale de Géogr. d'Égypte*, Vol. 17, 1929, pp. 61–77), consists of a series of notes intended to serve as a basis for a conference on the geography of the Faiyûm. Like Sandford and Arkell he links up the depression and the Nile Valley. His view of the early geological history of the region coincides in general with theirs, and he accepts the two lakes, for which he gives the maximum levels of 40 meters (131 ft.) and 23 meters (75 ft.) respectively. Apparently he considers the Faiyûm to have been cut down to −50 meters during the Quaternary, when it was a closed basin, as a result of normal surface erosion, desert erosion (wind action), and the action of chemical solvents. The aggrading Nile, in postglacial times, broke through the barrier between the Valley and the Faiyûm and created the Neolithic lake, which began to dry up with a slight cutting down of the Nile bed and the setting in of desert conditions until in Ptolemaic times it was at −40 meters (−130 ft.) or even lower.

From this brief summary of recent investigations it will be clear that the chief point of disagreement is the date of the excavation of the low levels in the Faiyûm basin and the conditions under which these were produced.

A. E. R. Boak

AUSTRALASIA AND OCEANIA

The Peoples of Norfolk Island. Seventy-five years have elapsed since the rapidly growing colony of the descendants of the mutineers of the *Bounty* was removed from the comparative isolation of Pitcairn Island to Norfolk Island (H. L. Shapiro: "Robinson Crusoe's Children," *Natural History*, Vol. 28, 1928, pp. 290–301). Two interesting questions arise in regard to this unique group. What are the characteristics of the descendants of that union between British seamen and Polynesian women—of offspring reared in an isolated area where they of necessity worked out a specialized and self-sustaining existence? And what have been the results of the removal of this unusual group to the greater freedom of Norfolk Island?

H. L. Shapiro, who on a visit to Norfolk Island made a careful study of these people, concludes that hybrid vigor is indicated to a marked degree. He found a decided increase in stature and size of family in the first generation and that this vitality, while diminishing, is after five generations stronger than in either of the parent stocks. Inbreeding seems to have produced no harmful effects (*idem:* Descendants of the Mutineers of the Bounty, *Memoirs Bishop Museum*, Honolulu, Vol. 11, No. 1, 1929).

At Norfolk Island, where there is regular communication with Sydney and Auckland, the results of isolation might be expected to disappear. However, it seems that, while outsiders in increasing numbers are mingling with the inhabitants and even settling there, the integrity of the group has yet been preserved. This is particularly significant in view of the usual deterioration of the Polynesian life as the result of European influences. Here a population of 902 exists on a volcanic island, a cadastral map of which shows only a negligible area still open for selection (Rept. Royal Commission on Norfolk Island Affairs, *Commonwealth of Australia, Parliament 1926*, [*Publ.*] *No. 62*). Of a total area of some 8000 acres only 600 are cultivated. Poor pasture long overstocked, land infested with Cape tulip and lantana, and forest reserves constitute much of the remainder. Whereas the amount of land in cereals has remained virtually constant for a long time, the area devoted to bananas has increased 200 acres within the last two years. The acreage in passion fruit also rose from 2½ to 48 acres. Citrus fruits, which formerly provided the chief item of export, have now become of little importance. The condition of the live stock is poor, owing

to inbreeding. It is estimated that at least half the animals have little or no economic value. Nearly all the butter is imported, and good beef is almost unprocurable. While it is doubtful whether the present Norfolk Island colony could be called flourishing, the most recent reports show increasing gains in acreage under cultivation, in the value of imports and exports, and in the general well-being of the people (*Territory of Norfolk Island, Ann. Rept. for the Year Ended June 30, 1928*, Commonwealth of Australia, Canberra, 1928).

POLAR REGIONS

Franz Josef (Fridtjof Nansen) Land. Dr. Gunnar Horn, now famed as the discoverer of the remains of the ill-fated Andrée expedition, is the author of "Franz Josef Land: Natural History, Discovery, Exploration, and Hunting" (Oslo, 1930). This booklet, Number 29 of the *Skrifter om Svalbard og Ishavet*, has been written in support of Norwegian interests in the archipelago.

It is claimed that one of the western islands of the group was discovered by a sealer from Hammerfest in 1865, thus antedating by some years the discovery by the Austro-Hungarian Polar Expedition (1872–1874). From that time Norwegian hunting parties have frequented the waters of the archipelago for their abundance of walruses, seals, polar bears, and white whales. An account of their expeditions has been compiled largely from old logs and from personal interviews with their skippers. To this is added a résumé of the scientific expeditions of various nations, the whole forming an excellent short history of the islands. Of particular interest are the data on variations in the state of the ice from year to year.

Last year, 1929, conditions were adverse. Among the expeditions of that year was one financed by Consul Lars Christensen which proposed among other activities to establish a meteorological and wireless station in the archipelago. It was planned and outfitted under the supervision of Captain Riiser-Larsen, and the scientific work was in charge of Dr. Horn. The expedition found the south coast blocked by a 60-to-80-mile-wide belt of pack ice, and attempts made though a month from mid-August failed to reach the coast nearer than twenty miles. Only the Russian ice-breaker *Sedov* got through last year. In contrast we have the conditions of the current year. So exceptionally favorable were they that Dr. Horn, heading an expedition on the motor sealer *Bratvaag*, decided to visit en route the islands between Spitsbergen and Franz Josef Land which usually are hard to reach—Stor, White, and Victoria islands. It was these same exceptional circumstances that permitted the discovery after thirty-three years of the Andrée relics on White Island. Incidentally it may be noted that the *Bratvaag* confirmed the corrections to the charted positions of Stor (Great) and White (Giles) islands made by the Worsley-Algarsson expedition in 1925, which found them placed too far east (see F. A. Worsley: Under Sail in the Frozen North, London, 1927).

Dr. Horn's booklet concludes with a short statement of steps taken by the Soviet authorities to establish sovereignty over Franz Josef Land or Fridtjof Nansen Land as it has been renamed by the Russian Academy of Sciences with the sanction of the government. An act of occupation of great scientific interest is the establishment of the most northerly meteorological and wireless station by the successful voyage of the *Sedov* in 1929 with Professors O. Schmidt, W. Wiese, and R. Samoilovich on board (see W. Wiese: Die Expedition des Eisbrechers "Sedow" nach Franz-Josefs-Land zwecks Aufbau einer meteorologischen Radiostation, *Arktis*, Vol. 2, 1929, pp. 126–128; and Rudolf Samoilowitsch: Das nördlichste geophysikalische Polarobservatorium auf Franz-Josef-Land, *Petermanns Mitt.*, Vol. 76, 1930, pp. 136–137). The station has been erected on Calm Bay, Hooker Island, in 80° 19′ N. and 52° 48′ E. It is hoped that it will be in full working activity by the time of the International Polar Year of 1932–1933.

The German Greenland Expedition, 1929. A report on the work of the "Deutsche Inlandeis-Expedition nach Grönland Sommer 1929" by the leader, Alfred Wegener, appears at the same time as he and his party take the field again for the main expedition (*Zeitschr. Gesell. für Erdkunde zu Berlin*, 1930, pp. 81–124). The objectives of the preliminary expedition were chiefly to find a feasible route from the coast onto the ice cap and to try out equipment of various types, especially the improved Mothes method for measuring the thickness of the inland ice.

A "reserve" line of advance was pioneered from Disko Bay, since that district opens up in the spring a month earlier than the Umanak district farther to the north, which had been fixed upon as in the latitude best suited for the stations of the main expedition of 1930–1931. The course from Quervainshavn, the *point d'appui* on Disko Bay, was taken in a northeasterly direction so as to reach the objective and was followed over the ice to a distance of 150 kilometers, where the elevation of the surface of the ice was measured by hypsometer as 2090 meters. The snow line was found at an elevation of about 1400 meters.

After having determined that both of the glacier outlets within the Umanak district offered no practicable route to the interior, the party was fortunate in finding a small glacier, hitherto unknown, which descended through a narrow valley from the inland ice and extended nearly to the sea. This glacier outlet offered an easily passable route to the interior. By this line of attack the party of four, with eight Eskimo helpers and with the use of dog sleds, made its principal advance over the inland ice to a distance of over two hundred kilometers, or about one-fourth of the entire distance to the east coast. When they turned back they had reached an elevation of 2510 meters.

Wegener's two profiles when compared with that of de Quervain in the near-by region, indicate that the inland-ice contours here rise toward the north. On the northern of Wegener's profiles an altitude was reached almost equal to the maximum elevation obtained by de Quervain some four degrees of latitude farther to the south. This tends to confirm earlier observations, which have appeared to indicate a northern central boss of the inland ice which is nearer the west coast, and a southern one nearer the southeast coast.

Above the Kamarujuk outlet glacier at elevations of the ice surface of 980, 1250, and 1590 meters, the last nearly 50 kilometers from the edge of the ice, echo soundings with an improved seismic device by Dr. Mothes were successfully carried out and showed that, although the ice surface rises toward the interior, the rock bed is depressed in that direction. (See also Ernst Sorge's account, "Die ersten Dickenmessungen des grönländischen Inlandeises," *Zeitsch. für Geophysik*, Vol. 6, 1930, pp. 22–31.)

To try out extensive observations on wastage and nourishment of the ice, pegs and bamboo poles were set at intervals on both sections; and these are to be re-read by the expedition in 1930 and 1931. Extensive measurements of glacier fronts were made to derive evidence of advance or retreat. In the Disko Bay district there are available measurements dating from 1912 by Mercanton, and from 1913 by Koch and Wegener. In the Umanak district those of Rink made in the middle of the nineteenth century can be utilized, and the more exact ones made by von Drygalski in the early nineties of the last century. With the exception of the great and small Karajak glaciers, which have their fronts practically where they were nearly forty years ago, all the glacier outlets from the inland ice that were measured showed that a retirement had occurred. The amount of this retreat was found to vary from about one-half kilometer since 1891 on the Sermilik glacier to 3.8 kilometers since 1893 on the Kome outlet. In general it was found that during the last thirty-five years very considerable retirement had occurred along the fronts of the outlet glaciers from the inland ice, whereas the small isolated glaciers of the Nugsuak Peninsula had not changed apparently in the last eighty years.

The most interesting meteorological observations relate to the direction and force of the wind over the inland ice. Here the party's experience was in character similar to that of all earlier expeditions over the Greenland ice cap, though they encountered more stormy weather than did de Quervain in 1913. Föhn storms always blew out from the interior with average direction east-southeast on both sled journeys. Only for a few brief intervals, and then when the wind had fallen off to near a dead calm, did the party record any other wind direction. A clockwise deviation of the wind from this nearly constant direction always preceded the coming of a storm and was so regular in this respect that it was made use of in forecasting the weather. A veering of the wind more toward the south gave a useful forecast of approaching bad weather and a veer in the opposite direction of improved conditions.

Much stress is laid upon the manner in which the outward-blowing föhn wind from the interior of Greenland, "very marked and regular," is "braked down" by the peculiar wind régime of the coast land. The narrower the coastal ribbon of land, the greater the domination by the glacial anticyclone. This is in harmony with the work of earlier explorers. The meteorological work did not include upper air studies, which are reserved for the main expedition of 1930–1931.

WILLIAM H. HOBBS

Field Studies in Greenland's Weather, 1930. Although attempts to span the distance between Europe and North America by airplane have hitherto been confined in the main to the general vicinity of the North Atlantic ship lanes, there is a growing feeling that the most promising route lies farther to the north, probably over Greenland. Not only would such a route reduce the length of the water hops but it would also be a more direct way between London and Winnipeg or Berlin and Chicago. At present the chief handicap faced by aerial transport in pioneering along this more northerly route is lack of information as to meteorological conditions over the entire route and more especially over Greenland.

There are now four expeditions in Greenland which are interested in studying weather conditions. Professor Hobbs is continuing the work in western Greenland begun in 1926 (see "The First Greenland Expedition of the University of Michigan," *Geogr. Rev.*, Vol. 17, 1927, pp. 1–35). The current (fourth) Greenland expedition of the University of Michigan will be divided. One party will be located near Upernivik (72° 47′ N.) in West Greenland, where upper air studies will be carried on for a complete year. Special glacial studies will also be made, including a resurvey of the front of the Cornell Glacier, 125 miles north of Upernivik, which was surveyed by Tarr's Cornell Expedition more than thirty years ago. The southern party will carry out upper air and glacial observations at Ivigtut in extreme south Greenland. These 1930–1931 stations are respectively about 450 miles north and south of Mt. Evans Station, the base of the second and third expeditions of the University.

The first volume of the technical reports on the earlier expeditions, which is devoted to aerology and edited by S. P. Fergusson of the U. S. Weather Bureau, is now complete and ready for printing.

Professor Alfred Wegener also is continuing meteorological, glaciological, and geological studies begun last year (see note above). A central station on the ice cap has been established some 250 miles in the interior. Ascent from the coast is made by the Kamarujuk glacier, a little north of Disko Island. It will be occupied by the meteorologist Dr. Georgi throughout the winter. Two other stations are also planned, one at Scoresby Sound, the other at Disko Bay. Bad ice conditions are reported on both east and west coasts, a state as regards the east coast confirmed by Captain Robert A. Bartlett who is leading an archeological and ethnological expedition on behalf of the Museum of the American Indian, Heye Foundation.

The *Geographical Journal* for July, 1930, gives the plans of "The British Arctic Air Route Expedition." Its object is "to complete the survey of this coast [for

200 miles north of Angmagssalik], to explore the interior, looking especially for high mountains, and to study the meteorological conditions both of the coast and the interior ice-cap over a period of at least a year." In command is Mr. H. G. Watkins, who carried out some useful exploration in the interior of Labrador in 1928–1929 ("River Exploration in Labrador by Canoe and Dog Sledge," *Geogr. Journ.*, Vol. 75, 1930, pp. 97–122). The main base has been established up the Sermilik Fiord from Angmagssalik, where a meteorological station will be established. A second station will probably be located about 140 miles inland on the ice. As much as is possible of the coast line between Angmagssalik and Scoresby Sound will be surveyed from the *Quest*, Shackleton's old ship, which has been chartered by the expedition, and the detail will be completed from aerial photographs. Next year it is hoped to make an experimental flight over Greenland on a proposed Europe-to-North America route.

It is reported that Dr. Constantin Dumbrava will establish at Scoresby Sound a station which he will occupy for a year in order to observe the weather and air currents with the special object of showing the feasibility of a safe route for a trans-atlantic air service via Greenland and Hudson Bay.

Heard Island. On November 25, 1853, Captain John J. Heard of the bark *Oriental*, Boston to Melbourne, discovered the island that now bears his name. Transcripts of the relative portion of his log and also of the journal kept by Mrs. Heard on voyage with her husband have been given to the American Geographical Society by Captain Sir Hubert Wilkins, who received them from Mr. Joseph J. Heard. The log runs:

"Pleasant breezes and passing snow squalls, the latter part clear and the first clear weather that we have had for twenty days. At 8:30 AM, made land; first took it for icebergs as no island is laid down on my charts, or in the Epitome. At 11:30 the clouds and haze cleared round and over it, revealing it to be an island. At noon the eastern end bore by compass NN (East) distance 20 miles, the western end bore by long NBW to distant about 20 miles by good observation. I make the west end of island 74.15 E lat. 53-10S. East end lat. 53 10 S by 74—40 E near the centre of the Island a high peak 5000 feet. Large quantity of birds about. Lat. observed 53 26S 74 19E 3¼ pt. 105 days out." Mrs. Heard in the journal adds, "I think it must be twin to Desolation Island, for it is certainly a frigid looking place."

Maury in his Sailing Directions, 1855, states that he had duly reported the discovery "to the government of the United States and the importance of sending a vessel of the navy to look after them [Heard and its small westerly neighbor McDonald Island] and fix their position was urged upon the Navy Department . . . " (p. 862). But no precise charting seems to have been carried out until the *Challenger* undertook the task in 1874. Meanwhile Heard Island had become the scene of a flourishing sea-elephant industry. The *Challenger* found 40 men so occupied. However, the island had been deserted for some years before the *Gauss* expedition touched there in 1902. More recently it has been visited from time to time by Anglo-Norwegian sealing expeditions.

Though on shore only a few hours, the party from the *Gauss* was able to make valuable contributions to the physical geography of an island where, as the leader has pointed out, a rich assortment of problems awaits the investigator (Deutsche Südpolar-expedition 1901–1903, Vol. 2, No. 3, 1908. This number deals with Heard Island; Part I, on the geography, being by the leader, Dr. Drygalski). So far the longest stay made on the island by a scientific observer is the eight days spent by Mr. Edgar Aubert de La Rüe in January, 1929. While engaged in geological exploration on Kerguelen Island for the Société des Pèches Australes, he seized the opportunity of a passage to Heard Island offered by a whaler proceeding on reconnaissance

towards Queen Mary Land (Un voyage d'exploration dans les Mers Australes: Ile Saint-Paul, Archipel de Kerguelen, Ile Heard 1928–1929, *Rev. de Géogr. Physique et de Géol. Dynamique*, Vol. 2, 1929, pp. 97–146). A preliminary note, "Sur la constitution géologique de l'île Heard," appears in the *Comptes Rendus* of the Academie des Sciences for July 17, 1929, pp. 129–131 (see also *Renseign. Colon.* (*Suppl. à L'Afrique Française*), June, 1930, pp. 342–355).

Mr. de La Rüe believes the volcanic history of the island to be more complicated than has been supposed. He finds rocks not recognized by the previous expeditions and points out that the calcareous rocks described by Reinisch (*Gauss* expedition) are not composed of remains of Bryozoa but of Globigerina, remarkable for the thickness of their shells, an observation confirmed by Sir Douglas Mawson (see p. 540). This interesting material occurs as angular fragments in the older regularly stratified tuffs of the Rogers Head region. The well preserved young volcanoes of Rogers Head apparently postdate the Pleistocene glaciation; but no manifestations of volcanic activity were found, nor were there signs of life in the central dome of the island, Big Ben or Emperor William Peak. In April, 1910, the *Wakefield*, steaming close along the western shore reported "immense clouds of smoke" rising therefrom (South Indian Ocean Pilot, London, 1923); and a similar observation was made by a French vessel in March (Découverte d'un volcan actif à l'île Heard, *La Géogr.*, Vol. 22, 1910, p. 287). Was it "smoke" or simply great clouds of snow blown from the summit by the wind? Neither the *Gauss* nor the *Challenger* nor Sir Douglas Mawson's expedition saw any emission of vapor, but the two latter had no completely clear view of the peak and the first-named saw it thus for a short time only.

Mrs. Heard understated the character of the island: it is even more desolate than Kerguelen and considerably colder. For the period January 15–22, Mr. de La Rüe found a mean temperature of 3.4° C., a figure which agrees well with the January temperature of 3.2° deduced by Meinardus (*Gauss* expedition reports). The maximum was 6.5°, the minimum probably about 0°. During the same period the figures for Kerguelen were mean 6.0°; maximum 15°; minimum 1.0°. The snow line was put at between 200 and 300 meters.

PHYSICAL GEOGRAPHY

A Flight to the Canary Islands for Meteorological Study. If transoceanic air lines working on a regular schedule are to be established, a detailed knowledge of flying-weather conditions over the ocean is needed. As a step in the project of acquiring the necessary information, the German Luft Hansa A.-G. sponsored an airplane flight to the Canary Islands for the purpose of making meteorological and other observations. Wilhelm Ernst, navigator of the expedition, has collaborated with Heinrich Seilkopf in presentation of the results (Meteorologische Beobachtungen auf dem Las Palmas-Flug der Deutschen Luft Hansa Juni und Juli 1928, *Aus dem Archiv der Deutschen Seewarte*, Vol. 48, No. 4, Hamburg, 1930).

The phenomena observed during the various stages of the flight may be roughly divided into two groups, the first being those due to the alteration of stream lines in air flow, and the second being those which are associated with the trade winds. The study of stream-line effects has assumed a greatly increased importance since the advent of the airplane and airship. The observations made during this flight thus become of more than academic interest; in fact, they may be regarded as contributions to the study of the "relief geography" of the lower atmosphere.

It was found on flying over Corsica and later over the Canary Islands that winds striking against elevated slopes were deflected in such a manner as to produce zones of accelerated flow on the one hand and zones of decelerated flow and turbulence on the other. The compression of stream lines on the windward side of the Islands and also between peaks and elevated capes resulted in currents that extended for

considerable horizontal distances beyond, while the disruption of stream lines on the leeward sides produced eddies, both horizontal and vertical, that were carried along the edges of the accelerated flow. In one case while the plane was approaching the leeward side of the Island of Santa Cruz de Tenerife, the bumpiness of the air foretold the presence of the island at a distance of over ten miles despite the fact it was not yet visible. The east and east-southeast Levant winds on blowing through the Strait of Gibraltar exhibited the same phenomenon.

A rather striking case of this effect was encountered off the south coast of France on the first day of the flight. An extensive low-pressure area over Sweden and off the British Isles had been transporting cold polar air southward for the few days previous. On the day in question a high-pressure area was centered over the middle Loire Valley while a low was centered over the Gulf of Genoa. Warm air lay over the entire Mediterranean Basin, and conditions were thus favorable for north and northwest winds to blow into it from the valley of the Rhone. A cold belt of stormy winds having a width of 160 miles and speeds ranging from 35 to 55 miles an hour was encountered just off the French coast. The imposing ranges of the Pyrenees and the Alps had deflected the air streams so as to direct them as would a funnel, producing a belt that extended more than 90 miles southwards.

In going through this region, too, the effect of the roughness of the water surface was felt. The turbulent sea stirred up the rapidly moving air to such an extent that the plane flying at a height of 70 to 100 meters seemed to participate in every motion of the waves below. Excellent opportunity was afforded for the study of conditions in the trade winds off the northwest African coast. The prevailing direction was from the northeast, while the wind speed varied from 4 to 24 miles an hour, the average being near 15. The winds here were found to be somewhat surprisingly shallow. A progressive increase in the depth of the trade winds southward towards the equatorial low-pressure region was indicated by the clouds which, forming at the inversion level, increased from a height of about 250 meters on the northern boundary to about 600 or 700 meters near the Canary Islands. The trades also became more shallow on approaching the African coast, where a least depth of 150 meters was observed.

A marked temperature inversion of 10° to 15° C. characterized the layer intermediate between the cold northeast trades and the warmer south-southwest antitrade winds above. In this intermediate layer the winds were light with variable directions mostly from the east and southeast. The boundary layer was wavelike in form, as was indicated in part by the fluctuations of the thermometer in the cabin of the plane while flying at a constant height of 500 meters. Flying in this warm layer was found to be inexpedient on account of the overheating of the motors.

The yellow coloring of an extensive bank of clouds observed on the flight south was found to be due to dust probably originating in the Sahara and carried by the easterly winds in the inversion layer. The layer could be traced for miles by the distinct band of yellow, even where there were no clouds.

Four or five shallow fog banks extending east and west at right angles to the wind as far as visible and having a width from north to south of about a mile were encountered on the flight south before the trades were reached. The return flight along the African coast brought the plane through fog banks extending over a region roughly 440 miles in width north and south. In both of these cases the fog banks were accompanied by temperature inversions of 10° to 15° C. at their upper limits.

In discussing the phenomena observed it is properly pointed out that air does not necessarily flow over mountains as water in a stream flows over an obstructing stone but that the rate of decrease of temperature with height in the free air is a governing factor. Thus if the rate in question is less than the adiabatic rate, viz. 1° C. per 103 meters for unsaturated moist air, the winds projected against the

mountain may flow around instead of over it, provided that the mountain is sufficiently high. The mechanism of this process depends in a great measure on the fact that the air in the stream flowing against the mountain cannot rise to any great extent beyond the level where it attains the same temperature as that of the free air adjacent to it. This fact is of practical importance and may have applications in predicting the flow of winds toward high-pressure regions. Further applications of similar studies may be foreseen in the field of local forecasting for mountainous regions.

The observations made in the trade winds further increase our appreciation of the importance of aerological data. We may see a parallelism between this work and that of Lieutenant Maury during the last century in charting the oceanic currents. The fact that practical use was made of the counterflow of the trades and anti-trades in reducing flying time to and from the Canary Islands foreshadows the time when general use will be made of such conditions on a large scale.

A formula for computing the depth of the trade winds from their speed was suggested for certain limiting conditions, but it is believed that a much larger number of observations are necessary before its validity can be established.

The question arises as to how the trade winds can maintain their identity near the African coast where they are so shallow. This is explained by the passage of the relatively cold northeast winds over the cold water upwelling off the Moroccan coast and over the cold Canary Current. The resultant cooling produces a further contraction of the lower air and a consequent lowering and intensification of the inversion.

The occurrence of fog 200 to 300 meters deep in the region off the northwestern African coast seems to require somewhat more for its explanation than the overrunning of cold air by warm. The authors did not discuss the influence of turbulence and eddy motion on the mixing of the two air currents and the possibility of discontinuities in the shallow trade winds of this region. Breaks in the flow of these winds would permit the descent of the warm anti-trades over the cold water with the consequent formation of fog. The facts that the inversion layer was wavelike in form and that this layer has been observed by others as low as 28 meters above sea level point strongly toward this possibility. The calming of the winds in the foggy area also sustains this idea. The suggestion of the authors that a thin wedge of cold air from the north or northwest may have been connected with the production of fog provides a possible answer when taken in relationship to other circumstances. The existence of warm moist air over the region previous to such an invasion of cold air would support their suggestion.

LOUIS P. HARRISON

GEOGRAPHICAL NEWS

Some New Geographical Periodicals. In the last few years an exceptional number of new geographical periodicals have started publication. Some of these emphasize or deal exclusively with their homeland and supply a good deal of valuable local material. Such a one is the *Hrvatski Geografski Glasnik*, or *Croatian Review of Geography*, published since 1929 in Zagreb under the editorship of Professor Artur Gavazzi. It plans to issue material dealing with Croatia, Jugoslavia, and the Balkan Peninsula. The first issues contain articles dealing with the city geography, physiography, climatology, and economic geography of Jugoslavia. Most of the material is in Croatian, but there are French and German résumés of many of the articles. The second issue contains an especially interesting article discussing the population of the Dalmatian city Split. The past ten years have witnessed a growth in the city greater than that of the whole period from 1857 to 1920. This is attributed to the return of Croatians to the district in consequence of the

shifting of boundaries after the World War and also to the linking of Split and Zagreb by railroad in 1925. The present population, the movement to the city both from the immediate neighborhood and from more distant points, and the place of the city as a trading center with a delimitation of its tributary area are analyzed. Additional studies of the rainfall and physiography of Split and its environs have appeared in *Geografski Vestnik*, the *Bulletin de la Société de Géographie de Ljubljana*, published since 1926 in Ljubljana. The latter publication has also issued a number of somewhat similar studies dealing with Ljubljana. In 1927 the Ukrainische Forschungsinstitut für Geographie und Kartographie was organized in Kharkov and in 1928 issued the first number of its review, the *Zapiski*, which also is essentially local in its scope.

Since 1927 the Norske Geografiske Selskab, Oslo, has issued a quarterly, *Norsk Geografisk Tidsskrift*, which replaces its previously issued *Aarbok*. In Stockholm there has recently appeared *Jorden Runt*, a well illustrated journal, which though universal in its scope contains a good deal of local material. The Geographical Society of Latvia has issued a new publication—*Geŏgrafiski Raksti* (*Folia Geographica*). The initial issue, Riga, 1929, contains an extensive account of the first Latvian Geographical Conference, 1927, with articles on the soils of Latvia, the cartography of Latvia, isotherms of Latvia, Lake Usmaiten, and Lithuanians in the United States. There are English, French, or German summaries of some but not of all the articles. Under Professor Stanislaw Pawlowski's direction *Études géographiques sur la Pologne du Nord-Ouest* commenced publication at Poznán in 1926. Its contents are in Polish with résumés in French or German.

The student of mountain regions has long looked to the *Revue de Géographie Alpine*, published by the Institut de Géographie Alpine (Université de Grenoble) (see *Geogr. Rev.*, Vol. 19, 1929, p. 504). A publication of somewhat similar nature dealing with the southwest of France and the Pyrenees is now being issued by the Institut de Géographie de la Faculté des Lettres de Toulouse (*Revue Géographique des Pyrénées et du Sud-Ouest*). The first issues are devoted exclusively to the Pyrenees and southwestern France. There are substantial articles on city geography (Lourdes and Limoux), the climate of the Ariège section of the Pyrenees, forestry in the Pyrenees, the Lot and Adour rivers, etc. Reference has recently been made in the *Geographical Review* (Vol. 19, 1929, p. 504) to *Les Études Rhodaniennes*, which is serving the same function for the Rhone Valley.

To one not reading Hungarian the new quarterly *Geographica Hungarica*, Budapest, edited by Michael Haltenberger, will be especially welcome. An attempt is made to present to the reader a record of all geographical material published in Hungary. Where the original work has been issued in a language accessible to the average western European the title alone is given; but where the work has been published in Hungarian there is a German translation of the title with a brief summary of the content of the article. There are also brief personal and geographical notes.

In the British Dominions two recently organized geographical societies are issuing journals. The Canadian Geographical Society (see *Geogr. Rev.*, Vol. 20, 1930, p. 341) began to issue the monthly *Canadian Geographical Journal* in May, 1930, and the Geographical Society of New South Wales is publishing the *Australian Geographer*. The former has stated as its aims the publication of a "monthly magazine . . . which will be devoted to every phase of geography—historical, physical, and economic—first of Canada, then of the British Empire and of the other parts of the world in which Canada has special interest." The latter has as its goal the collection and dissemination of geographical data concerning Australasia and cognate regions. The first issue, 1928, contains as its opening article a study by Griffith Taylor on "The Status of the Australian States: A Study of Fundamental Geographical Controls."

Since 1928 the Sociedad Geográfica de Cuba has issued a quarterly *Revista* devoted

in large part to the geography and history of Cuba. With the July, 1930, issue the *Pan American Magazine* became the official organ of the Geographic and Historical Society of the Americas.

The Bristol Record Society. Students of historical geography will welcome the foundation of the Bristol Record Society in Bristol, England. Its purpose is to encourage study of the wealth of material in the archives of that ancient trading city. "The story of the trade of Bristol for a thousand years," said Mr. Baldwin when Prime Minister, "is the story of the trade of England" (Captain Edgar C. Smith in an address before the British Association, "Science and Industry in Bristol," *Nature*, September 6, 1930). The archives offer sources for the study of shipping, exploration, the slave trade, and the development of commerce from early times, and especially on matters relating to America in colonial days. Information regarding the society may be obtained from its Honorary Secretary, the University, Bristol.

OBITUARY

Jean Brunhes. Announcement of the presentation of the Cullum Geographical Medal of the American Geographical Society to Jean Brunhes, professor of the Collège de France and member of the Institut de France, was already in press when a cable was received announcing his death at Paris on August 25. He was in his 61st year.

Brunhes' fame rests primarily on his "La géographie humaine," in which, as the editors to the English edition point out, he introduced a "new point of view in human geography and a new method of analysis." This book, first published in 1910 and now in its third French edition, is more than a classic. It is one of the few essential works on the list for the student of geography. The method of Jean Brunhes as he himself has stated it lies "in the observation of phenomena, as direct as possible, localization, comparison, and investigation of causes physical as well as human. To this should be added—since it is primarily a question of visible and tangible works—photographic documentation as well as documentation by means of maps." ("Human Geography" in "The History and Prospects of the Social Sciences," edited by H. E. Barnes, 1925.) This method he has consistently pursued from his first important published work the admirable "L'irrigation, ses conditions géographiques, ses modes, et son organisation dans la péninsule ibérique et dans l'Afrique du Nord," Paris, 1902, dedicated to his master, Vidal de la Blache, and published while he was teaching at the University of Fribourg in Switzerland. So in the volumes "Géographie humaine de la France" (Vol. 1, 1920; Vol. 2, with Pierre Deffontaines, 1926) which form the introduction to Hanotaux' "Histoire de la nation française," he abandons the strictly regional method to gain a freer field for the synthesis of observation and ideas (see *Geogr. Rev.* Vol. 11, 1921, pp. 430–433). A still wider application of these principles is found in "La géographie de l'histoire," 1921, written in collaboration with Camille Vallaux (analyzed by Douglas Johnson, *Geogr. Rev.*, Vol. 12, 1922, pp. 278–293), an illustration of his tenet that "human geography recognizes that human energy should be classed among the most potent factors that tend to change the crust of our planet." This same line of interest led him to prepare an adaptation of Isaiah Bowman's "The New World," published in 1928 as "Le Monde Nouveau."

Brunhes' work was remarkable not only for the careful observation of the "essential facts," based in large part on his own travels, but in the artistry, the "spirit of finesse" that he brought to their interpretation. He was a writer and an orator of distinction and drew many to his courses in the Collège de France, where he held the chair of human geography since 1912.

GEOGRAPHICAL REVIEWS

Exploration in the Relations between Weather and Health

Ellsworth Huntington. **Weather and Health: A Study of Daily Mortality in New York City.** 161 pp.; diagrs., bibliogr. *Bull. Natl. Research Council No. 75*, Washington, 1930. $2.00.

One of the most useful things accomplished by the National Research Council, perhaps the most directly useful of all to scientific research, is the Bulletin series of monographic treatments of definite fields of scientific activity in research. Many of the monographs have been prepared like "Weather and Health" by a chairman, selected because of his peculiar interest and competence in the field, with the advice of a committee of experts, each informed upon some aspect of the field. That such organization for collective effort is effective can be seen from the results.

Adequately to review "Weather and Health" in any critical way whether in approbation or disapproval is impossible for one individual—that, too, would take a committee of which the chairman should again have peculiar competence in the meteorological and medical sciences. I can only point to some matters of methodology and discuss some results or hypotheses, bearing in mind the fact that the relation of climate to men has been a lifelong pursuit of the author and that, in a topic so involved with many variables and often with no specifically known etiological agents, the statistical method is the only approach and the results of its application have doubtless to be somewhat guided by the feelings of the author toward the whole mass of evidence available of which much cannot well be incorporated into the statistical set-up.

The technique is to study the weather conditions on the day of death for deaths in New York City over 2170 days, April 15, 1882, to March 24, 1888, and also the weather conditions on neighboring days. The elements of the weather used are mean daily temperature, mean relative humidity, and change of mean temperature between successive days or other brief periods immediately antecedent to death. Precipitation, direction and intensity of the wind, and barometric pressure are not used. The method of partial correlation was considered but not employed; instead, tabular and graphical portrayal is made. This decision is to be commended. The research is to a large extent exploratory, and one had best use his eyes. The especial graphical technique relied upon is that of the contour line chart, one natural to the geographer, in which the contour lines represent the number of deaths per day and the abscissae and ordinates are two of the three weather variables—such a chart being called a climograph. To one used to it the contour line chart is an excellent and very informing device, exhibiting at a glance not only the equi-favorable conditions (level lines) of various degrees but also the rapidity with which conditions are changing for changes in the variables. The ordinary methods of correlation would have represented the number of deaths per day linearly in terms of the three variables, making all contour lines straight; and a glance at the climographs shows that any such representation would have been unreal.

Some conclusions are *a priori* obvious. For example, any disease that causes deaths with a pronounced seasonal variability must show worse conditions as measured by deaths for those temperatures that prevail during the season of high incidence and better conditions for those that prevail during the period of low incidence. Thus pneumonia and influenza, being normally winter diseases, will show a higher temperature as optimum for us humans than diarrhea and enteritis,

which are summer diseases. And this the author finds, as the following table will show:

Disease	*Optimum*
Deaths under 5 years except pneumonia and influenza	45°
Deaths all ages, all causes	63°
Deaths over 5 years except pneumonia and influenza	67°
Deaths all ages from pneumonia and influenza	80°

If we were to tabulate deaths under 5 years including pneumonia and influenza, we should expect to find the figure of 45° raised. The only contribution expected of the detailed tabulation is that of the quantitative estimate of the optimum temperature (that of least fatality) and of the quantitative estimate of the degree of variability of fatality with temperature.

As relative humidity shows no such marked seasonal fluctuation as temperature, we should expect a more complicated situation. Thus, as deaths under 5 years from all causes at that epoch reach a very pronounced peak in the summer and as humidity is on the whole high during the same season, we must expect to find that increase in humidity is unfavorable; but if we separate according to temperatures we should find perhaps very little effect or even the opposite effect. The author tries to unsnarl the complications and comes to a judgment about which he is insufficiently confident to be dogmatic. The general conclusion seems to be that, on the whole, high humidities are favorable and that the combination of low humidity and low temperature is distinctly unfavorable.

The study of the effect of interdiurnal variability of temperature is highly interesting, as it reaches the result that variability is favorable in a rather complicated way: namely, a rise of temperature is unfavorable, but a drop of temperature is more favorable, so that in balance variability is beneficial. "When temperature, humidity, and variability are all combined it appears that the ideal day is one on which the average temperature is about 65° and the relative humidity nearly 90 per cent. The preceding ten days or so should have been characterized by fairly strong changes of temperature averaging 4°. These should culminate in a drop of 10° or 12°." Who would not desire to live on such a day!

The title of the monograph is "Weather and Health." The data deal only with weather and death. What right have we to assume that the sort of day on which one dies is unfavorable to life? Except by fatal accident a healthy person does not die in a day: he can stand almost any New York weather for a few days, and ordinarily in that time there will come a change. It is very complicated. In the series of three figures numbered 38 it is clearly shown that more persons die on the day hotter than the previous day than upon one colder and that on the whole the relation of increased number of deaths to amount of rise (positive or negative) is fairly linear at the rate of about one-half per cent per degree rise of temperature, although in all three cases a very severe drop in temperature is less favorable than one moderately severe. Now on the day of death the patients are presumably moribund. Setting-up exercises or a morning shower, which are often considered hygienic measures for healthy persons, would probably do them no good either.

An infectious disease originating in a period of unfavorable weather may cause most of its deaths in quite different meteorological circumstances. This may arise either from the delay caused by the normal duration of the disease in the individual case or from the time necessary to the development of the epidemic. As most of the infectious diseases in New York are of short duration, the first cause would not affect results dependent on the general season but only those arising from day to day fluctuations in the weather. But the second cause might be very effective. Epidemics may be rather slow in running their course. It is not certain that in New York the totality of slow-running epidemics produce enough deaths delayed into

the season of weather unfavorable to the disease to give a fallacious appearance of weather considered as unfavorable when based on deaths. The idea would, however, be worth examining. Pneumonia is sometimes as high in mid-May when the temperature is about the normal optimum of 65° as it is in mid-December with a temperature of 30° lower. How far pneumonia can be considered epidemiologically infectious is of course doubtful. So is the author's conclusion as to the simple relation between temperature and the chance of contracting pneumonia, as I believe a glance at the corresponding figures of San Francisco would show; for there with very little seasonal change of temperature there is a marked seasonal fluctuation of pneumonia. That temperature is an important factor is probable, but so may be hours of daylight, which is highly correlated with temperature.

One of the striking findings of the author is that cool weather (30°–50°) which is dry (relative humidity 40–50 per cent) is bad, the deaths per day in such weather being high for most of his temperature-humidity climographs. This is often considered "bracing" weather. The finding deserves further study. Indeed, as Huntington states, there are very many items suggested by his graphs that point to interesting possibilities for subsequent investigation. The monograph may, in fact, almost be characterized as an exploration in search of suggestions for research rather than as a contribution to our relatively definitive knowledge in its field.

E. B. WILSON

SOIL GEOGRAPHY OF THE UNITED STATES

LOUIS A. WOLFANGER. **The Major Soil Divisions of the United States: A Pedologic-Geographic Survey.** xxi and 150 pp.; map, ill., bibliogr., index. John Wiley and Sons, Inc., New York, 1930.

For many years the detailed survey of soils in widely distributed areas in the United States has produced sufficient information for the division of the country into major soil groups, the regionalism being based upon the common characteristics of typical mature soils. Dr. Wolfanger's excellent little book essays to present such a division, and it is gratifying to see the pioneer work of Dr. Curtis F. Marbut, Chief of the United States Bureau of Soils, expressed in this contribution to the science of soil geography. Soils are no longer regarded simply as the surficial members of geological formations but as formations in themselves. Soils have attributes, which include chemical composition, physical properties, structural features, and other inherent characteristics that should be studied objectively. This means the abandoning of old standards of classification—whether they be geologic, topographic, or climatic—in favor of the attributive system. The work of the Russians has found application in the United States, and no doubt continued study in this country will reveal many new features and relationships. The division of the country into major regions must be based upon the inherent attributes of mature soils developed upon level or only gently rolling surfaces where there has not been continual removal nor the periodic addition of new material.

Using Marbut's nomenclature, the writer divides the country into the eastern pedalfers characterized by their aluminum and iron content and particularly by the fact that they are non-lime-accumulating. This great group of soils occupies the humid eastern half of the United States and is divided into the podsols, gray-brownerths, red-and-yellowerths, ferruginous laterites, and the prairyerths. The last-named has a north-south orientation, but the other four extend in general east and west. For each of the soil types the writer presents chemical analyses to show the differences between the several horizons and the five soil groups.

The pedocals of the drier western portion of the United States are characterized by the accumulation of the salts of the alkalies and the alkaline earths. The divisions named from east to west include the blackerths, chestnuterths, brownerths, and

grayerths. Also there is a large area of rough broken land with no soil or mantled with only a scant amount of parent material in the earliest stages of soil evolution. The divisions of this group show a close relationship to the amount of precipitation which also affects the character of the vegetation, and this in turn has left its impress upon the soil. For example, blackerths have developed in the more moist areas under grassland formations.

In a chapter on "Geographic Relationships" the writer points out some of the general correlations between soil regions and other areal phenomena. There is, no doubt, a genetic kinship between soils, climates, and the vegetal associations; but, before correlation proceeds too far, soils should be studied with an objectivity that is truly scientific. No doubt soil quality is expressed in the intensity of their utilization for agriculture; and, furthermore, each major soil division is characterized by one or more crops particularly well adapted to the pedologic environment. But the agricultural and pastoral utilization of the pedocals is obviously related to the westward decrease in precipitation rather than to the character of the soils. The author's demonstration that the utilization of the pedalfers varies not only with the climatic environment but with the character of the soils is a useful principle of geography. He ranks the prairyerths as the most productive of the pedalfers and the ferruginous laterites next to the podsols, which are lowest. The productivity is measured by the proportion of the land under crops. The student of geomorphology might logically inquire as to how far the productivity may be related to the conditions of slope, especially in regions where the statistical data apply to areas mainly mantled by young soils. The quantitative determination of the value of these great soil groups opens up interesting problems for further research. There must come also some refinements in the delineation of soil provinces; but, these are minor criticisms, and pedology and geography have been enriched by this important contribution.

GUY-HAROLD SMITH

VIRGINIA-NORTH CAROLINA BOUNDARY

WILLIAM K. BOYD, edit. **William Byrd's Histories of the Dividing Line Betwixt Virginia and North Carolina.** With introduction and notes. xxvii and 341 pp.; maps, index. North Carolina Historical Commission, Raleigh, 1929. 10 x 7 inches.

William Byrd's "History of the Dividing Line Betwixt Virginia and North Carolina" is an old favorite in the historical literature of colonial America. It has been in print since 1841 and has appeared in at least two editions before this. But his "Secret History of the Line," a manuscript in the possession of the American Philosophical Society, is now published for the first time. It is safe to say that few known manuscripts, if any, of the early part of the eighteenth century are more deserving of publication, and it is a pleasure to add that the method adopted by Professor Boyd in editing it evokes unqualified admiration. Instead of printing the "Secret History" as a separate document he has collated it with the familiar "History of the Dividing Line," giving us the former narrative on the right-hand page and the latter on the left. Thus at all times an immediate comparison of the two texts is possible.

The story of the boundary dispute between Virginia and North Carolina is briefly this. When Charles II granted Carolina to Ashley, Albemarle, and others in 1663, he gave it the limits of the old Carolana project of 1629. Its northern boundary was the thirty-sixth parallel from the Atlantic to the Pacific. As it was not clear that this included the settlements already existing on the Chowan River, the king obligingly sliced off a bit more of the Old Dominion and added it to Carolina. This was in 1665. By the charter of that year the dividing line between Carolina and Virginia was moved northward to approximately thirty-six degrees thirty minutes.

For a number of years Virginia ignored the new line; but by the beginning of the eighteenth century the claims and counterclaims arising from conflicting jurisdiction in the disputed area had become so wearisome that the northern province was willing to concede much in order to have the matter settled. In 1715 a compromise boundary was agreed upon by Governors Eden and Spotswood, and in the winter of 1727–1728 each province appointed commissioners who should survey and determine it. Of the Virginia commissioners, William Byrd appears to have been *primus inter pares*. On March 5, 1728, the two delegations with their surveyors and men—also a chaplain and a copious supply of liquor—met "at the South Shoar of Old Coratuck Inlet," and the game began.

Inevitably the joint commission lacked harmony. The old-line Virginians regarded the North Carolinians with amusement not unmixed with scorn. The attitude of the North Carolinians was what one might expect under the circumstances, and one gets the impression that the whole enterprise might have gone on the rocks on more than one occasion had it not been for the good nature and good sense of William Byrd. His principle, as expressed in his own words, was: "When People are join'd together in a troublesome Commission, they shou'd endeavor to sweeten by Complacency & good Humour all the Hazards & Hardships they are bound to encounter, & not like marry'd People make their condition worse by everlasting discord" (p. 89). He lived up to his principle, too, but it was not always easy for him to do so; for William Byrd, like the rest of us, had his likes and dislikes. He cared little for North Carolinians and less for Irishmen. Fate and the Virginia authorities had decreed that one of his colleagues should be an Hibernian of the loud-mouthed type. Of him Byrd has little to say in the "History of the Dividing Line"; but in the "Secret History," which is a sort of safety valve, he speaks his mind and is vastly entertaining.

Byrd speaks his mind, but for the actual names of the members he substitutes fictitious appellations chosen with peculiar appropriateness. Thus he himself appears as "Steddy"; his surveyors as "Orion" and "Astrolabe"; the North Carolinians as "Judge Jumble," "Plausible," "Shoebrush," "Puzzlecause," and "Bootes"; the chaplain as "Dr. Humdrum"; and the Irishman as "Firebrand." Thus there is a suggestion of "Pilgrim's Progress,"—but how different a progress was this! Even historians acquainted with the manners and customs of the frontier of the eighteenth century will probably be surprised by the frequency and violence of the amorous episodes that enliven the narrative.

The descriptions of the Dismal Swamp and of the back country are both instructive and stimulating. The wilderness teemed with deer, wild turkeys, rattlers, and (towards the mountains) bears. Occasionally the party encountered a buffalo, an elk, a wildcat, or a panther. To the reader the primeval American forest becomes a reality as never before. Byrd loved it—adventure, hardship, and all; and his enthusiasm permeates the story from beginning to end.

Those of us who delight in the oddities of state boundaries—such as the arc that limits Delaware on the north, the curious jog made by the town of Southwick in the line that separates Massachusetts from Connecticut, or the choice of St. Marys River instead of St. Johns River as part of the Georgia-Florida boundary—are especially indebted to Professor Boyd for giving us the key to the idiosyncrasy of the Virginia-North Carolina line. One is apt to picture that boundary as running westward in a straight line from the Atlantic to the mountains. But it just misses doing that. At one point it turns suddenly southward, keeps that course for about half a mile, and then resumes its original direction. The wherefore of this vagary is to be found in the compromise Proposals agreed upon by Eden and Spotswood in 1715. But it is not to be found in that document as printed in the Appendix to the "History of the Dividing Line" in any edition. Apparently through oversight on the part of a copyist the very clause that explains the peculiar course of the

boundary was omitted from the text. It runs thus: "That if the said West Line cuts Blackwater River to the Northward of Nottoway River; then from that point of Intersection, the Bounds shall be allowed to continue down the middle of the said Blackwater River to the middle of the Entrance into the Nottoway River, and from thence a Due West Line shall divide the said two Governments" (Colonial Records of North Carolina, Vol. 2, p. 223). One of Professor Boyd's footnotes (p. 12) guides the reader to the full text of the Proposals, without which he would be entirely at a loss how to explain the line adopted and surveyed in 1728.

LAWRENCE SHAW MAYO

EARLY SPANISH VOYAGES ALONG THE CALIFORNIA AND OREGON COASTS

H. R. WAGNER. **Spanish Voyages to the Northwest Coast of America in the Sixteenth Century.** viii and 571 pp.; maps, bibliogr., index. (California Hist. Soc. Special Publ. No. 4.) California Historical Society, San Francisco, 1929. $15.00. 11 x 8 inches.

In this volume is brought together practically all that is known concerning the voyages made by the Spaniards along the California and Oregon coast line between 1539 and 1602.

The series opens with an account of the epochal voyage of Ulloa in 1539, and this is perhaps the most interesting record in the entire volume. The compiler has been able to reproduce Ulloa's original journal, has furnished an adequate translation, and has thus brought into full relief what has hitherto been one of the most elusive and tantalizing episodes of early exploration.

Ulloa's most important work on this voyage was done in the Mar Bermejo, or Gulf of California, which he was the first to enter and explore. The journal of his progress up the east side and return down the west side of this inland sea is so detailed and accurate that it would almost serve for sailing directions today.

The region at the head of the gulf, in which he had found himself embayed amidst numerous shoals and tidal currents, he called the "Ancon" of the Mar Bermejo. In a comprehensive explanatory note concerning the sixteenth century meaning of this term, the compiler inclines to the view that Ulloa simply meant an estuary; but he quotes Preciado's contemporary description of the appearance to "the mouthes of certain lakes," and a surmise "that some great river might be the cause thereof."

This is so graphic and to one who possesses local knowledge of the region, as the reviewer does, is so explanatory, that the probable meaning of the word "ancon" as a tidal channel connecting adjacent bodies of water, seems quite plain.

Ulloa was at the mouth of the river on September 28, 1539. An investigation has brought to light the interesting fact that full moon occurred on the 26th day of that month and year; so these early explorers witnessed the conditions that always obtain in the estuary a day or two after spring tides, when the numerous sloughs and large channels along the shore line are redelivering into the estuary the tidal water that has inundated the enormous expanse of mud flats during the preceding few days.

The impression so gained would also doubtless account for the delineation of the head of the gulf in the Cabot planisphere (Pl. 5), and perhaps in Lorenzana's map (Pl. 8) as having more than one river debouching into it.

The question of the subsequent course and termination of Ulloa's voyage is involved in doubt, except that he passed up the outer coast of the peninsula and so practically determined its configuration.

No direct account is given of the voyage of Alarcon, which was also made to the head of the gulf in the following year; and the account proceeds with a general description of the political conditions and situation in New Spain and so to the voyage of Juan Rodriguez Cabrillo, the first explorer of the coast of upper California.

The next section of the volume deals with the wider field of the discovery and

occupation of the Philippines and of the return voyages of Arellano, Rodriguez, and Espinosa to the American coast. Arellano's feat of successfully crossing the still unknown and uncharted Pacific in a vessel of only 40 tons was in every way remarkable and ranks high as an instance of courage and enterprise.

Juan de la Isla, Francisco Gali, Pedro de Unamuno, and Rodriguez Cermeño all followed the course laid by Arellano but were generally more successful than he had been in making their landfall in a high latitude.

Perhaps, as the compiler is inclined to believe, no direct effort was made by any of these voyagers to discover an entrance that might mean a short route to the North Sea, although there seems to be every probability that such a search was in the air.

Little information of real value had been gained from these homeward-bound voyagers from the Philippines, whose chief concern was doubtless to reach their home ports as speedily as possible, and so it was at length determined to equip and dispatch an expedition under a competent leader for the sole purpose of exploration and discovery. Sebastian Vizcaino was selected as the commander of this enterprise, and an account is given of his career and various activities prior to the well known voyage of 1602.

The body of the volume closes with an account of the project to found a settlement at Monterey, as a result of the report and recommendation of Vizcaino.

The notes, appendixes, and other explanatory matter with which the volume terminates are so copious and so necessary for the adequate interpretation of the text that one questions whether it would not have made the work more useful and convenient for the student, to have bound them in a separate volume or placed them in a portfolio.

The collection and interpretation of these interesting records represents the highest type of historical research work, and the volume can be most cordially recommended to the student or general reader.

GODFREY SYKES

HURRICANES OF THE ANTILLES

SIMÓN SARASOLA. **Los huracanes en las Antillas.** 2nd edit. With appendix, Génesis y evolución del huracán de 20 de octubre de 1926 y catálogo de ciclones en la Isla de Cuba de 1865 a 1926, by M. Gutiérrez Lanza. xv and 254 pp.; maps, diagrs., ills. Bruno del Amo, Madrid; La Moderna Poesía, Librería "Cervantes," Habana, 1928. 20 ptas. 10 x 7 inches.

The first part of this volume is devoted largely to a review of the admirable pioneer work of Benito Viñes, S. J., of Belén College, Havana, who devoted the last twenty years of his life to the study of hurricanes of the Antilles. We owe much of our present knowledge of tropical storms to members of the Jesuit Order—to Algué, Froc, and Dechevrens for storms of the Pacific and to Viñes, Sarasola, and Gutiérrez-Lanza in the Atlantic. All of these students of tropical storms have devoted years of patient study to a better understanding of the laws of storms and to their practical application in forecasting the probable path and intensity of the vortex.

The author attaches great importance to the conclusions of Viñes as announced in his well known "fundamental law of tropical hurricanes," namely:

"In the West Indian cyclones the rotation and cyclonic circulation take place in such manner that the inferior currents, as a rule, converge more or less toward the vortex; at a certain altitude the currents follow a nearly circular course, and higher still their course is divergent. It is particularly to be noticed that this divergence is all the greater as the currents occupy higher altitudes, until a point is reached where the highest cirrus clouds are seen to move in a completely divergent radial direction."

This generalization so far as it refers to surface and intermediate currents in

hurricanes is roughly applicable; but the assertion of a radial outflow from the vortex of the storm has been challenged, especially in the light of more recent studies. During the past ten years observations of the higher atmospheric currents have been made in several localities within the hurricane area. A careful study of the daily records of sounding balloons and cirrus clouds at San Juan, Porto Rico, gives very little support to the claim that at the cirrus cloud level there is a radial outflow from the vortex of the hurricane, while observations of air movement at the cirrus level are directly opposed to the theory of a radial or divergent outflow above the vortex. Observations made at Havana are necessarily confined mostly to action in or near the recurve of the storm, while observations at San Juan are associated entirely with conditions in the first branch or westward movement of the vortex of the storm.

Much stress is laid upon the value of Viñes' generalization regarding the movement of winds within and near the vortex of the storm as an aid to navigators. Local signs of an approaching hurricane do not, however, have the important significance which was attached to them in earlier years. In these days of easy radio communication with ships at sea the nearest central reporting station keeps the navigator advised by frequent broadcasts of the location and probable movement of the vortex of the storm.

The second part of the volume is devoted to a brief review of more recent advances in our knowledge of the laws of storms and in the art of forecasting.

The author refers to discrepancies in the chronological lists of hurricanes of the Antilles published under the auspices of Belén College, Havana, and those published by the U. S. Weather Bureau. In view of the fact that no two of these lists cover the same period or identical areas, and in the absence of any common agreement in the classification of tropical cyclones on a basis of intensity, such discrepancies are bound to be considerable.

The volume is attractively printed and is a valuable book of reference for students of meteorology, especially for those who are dependent upon sources in the Spanish language.

OLIVER L. FASSIG

ARCHEOLOGICAL EXPLORATION IN THE EASTERN PERUVIAN ANDES

HIRAM BINGHAM. **Machu Picchu, a Citadel of the Incas: Report of the Explorations and Excavations Made in 1911, 1912 and 1915 under the Auspices of Yale University and the National Geographic Society.** xiii and 244 pp.; maps, diagrs., ills., index. Yale University Press, New Haven, for the National Geographic Society, 1930. $50.00. 12 x 8 inches.

Dr. Bingham here presents the results of the exploration and excavation of Machu Picchu accomplished on his 1915 Peruvian expedition. (For a general summary of the expedition see *Geogr. Rev*, Vol. 2, 1916, pp. 466–467.) The ruins of this "refuge" city, whose very name has been "lost in the shadows of the past," occupy a steep, narrow ridge between Machu Picchu (10,300 feet) and Huayna Picchu (9060 feet). These greater and lesser peaks lie in a bend of the Urubamba River, here at an elevation of 6400 feet above sea level, and some fifty miles north of Cuzco.

The preliminary investigations made by the 1911 and 1912 Peruvian expeditions were described by Dr. Bingham in "Inca Land" (1922). The current volume analyzes the plan, architecture, and masonry of the city; describes the roads leading to it and the burial caves on the eastern side of the ridge; examines the pottery, which with few exceptions is purely Inca in design and workmanship though including some uncommon types, metal articles, and other objects of material culture—all illustrated by exquisitely reproduced line drawings. Many photographs in collotype convey well the impression of this picturesque site. There is a separate map of the ruins on a scale of one inch to 120 feet.

In the last chapter Dr. Bingham essays the identification of the city, of which no specific mention has so far been found in the writings of the Spanish historians. He believes it to be the Tampu-tocco of Montesinos, the place whence issued Manco Ccapac, the founder of the Inca Dynasty properly so-called. The problem is one for the archeologist and historian: in "Machu Picchu" Dr. Bingham has given it an engaging setting.

Modern Greece

E. G. Mears. **Greece Today: The Aftermath of the Refugee Impact.** xxii and 336 pp.; maps, diagrs., ills., bibliogr., index. Stanford University Press, Stanford University, Cal., 1929. $5.00. 9 x 6 inches.

The ordinary American traveler in Greece cannot distinguish between the classical period and the modern civilization. If he be a man given to public addresses, he congratulates the Greeks on their ancient culture and cites a few of the great names without much realization of their respective places in the galaxy. Mr. Mears is not that sort of traveler. He writes an excellent gazetteer of modern Greece in which may be felt the life pulsating through that eager community, highly mercantile and materialistic, but at the same time infected with the Hellenic idea and with the spiritual values of modern European culture. Mr. Mears gives the picture of this throbbing life and yet here and there sketches in a bit of the color of antiquity, just as to a traveler leaving the fume-filled air of the lead mines at Laurium (the ancient silver mines where rebellious slaves were sent to perish) might suddenly appear the Temple to Poseidon at Sunium looking out over the wine-dark sea.

The book contains all of the material the traveler or reader might desire to acquaint himself extensively with modern Greece; details of course will have to be found in more intensive studies. There is plenty of material from which one may judge the present and forecast the economic future of a country whose prosperity seems to be growing rapidly. There is an adequate treatment of the thrilling story of the 1,200,000 refugees—the number has recently been fixed at this figure by the census taken by the Refugee Settlement Commission—and the contribution they are making to the economic and political strength of the republic. The author, though wholly unbiased, cannot avoid an expression of the admiration felt by all who have come into contact at first hand with the supreme trial of the Greeks and the heroic efforts by which they overcame it. There are discerning comments on the psychology of the Greeks, the ἀτομισμος which makes it difficult for them to coöperate in economic and political affairs but has its good side in individualistic self-reliance.

The proportion assigned to the various topics is sound. It is in truth libelous to call the book a gazetteer. It has the facts, but the writing is good—terse, lively, as by one who can communicate amusement, and unpretentious. The maps are commercial maps; better ones might have been had for so full a study. There are some slips such as in spelling and in some geographical items and classical allusions, but they are not serious. In view of the fact that there has been no Baedeker or other guidebook of Greece published since 1912, this is the best book for a traveler about to enter that enchanted land.

Charles P. Howland

The Problem of Chinese Origins

Chi Li. **The Formation of the Chinese People: An Anthropological Inquiry.** 283 pp.; maps, diagrs. Harvard University Press, Cambridge, 1928. $5.00. 10½ x 7 inches.

Dr. Li modestly states that the aim of his monograph is simply to show the complexity of the problem of the composition of the Chinese people and to suggest some of the ways of solving it. In this he has succeeded abundantly. But he has done

much more; for his book represents the first serious attempt to attack the problem through a carefully reasoned study of the material thus far available—anthropometrical, historical, and to a certain extent linguistic. The methods of investigation utilized by him have been at once original and effective.

In his opening chapter Dr. Li poses the problem which he has set himself. He points out that the Chinese, like every other human group that has ever existed, have responded at all times to the various influences exerted by their physical and cultural environment. One of the chief ways in which this process has been acting is through the progressive absorption by the "We-group"—the original Chinese people of three and four millenniums ago—of various "You-groups," consisting of non-Chinese elements.

The physical traits of the Chinese people are described. The lack hitherto of systematic anthropometrical studies is noted; considerable space is devoted to tables of measurements and their elucidation. Among other things, the nonexistence of the commonly postulated sharp contrast in physical type between north and south is clearly shown; differences exist, it is true, but they are far more complex than has been supposed. We are told that there is apparently present in the Cantonese population about one per cent of a nanoid or dwarf element; this statement is of particular interest in view of the fact that a certain amount of evidence exists for the former occurrence of a Negrito or Negritoid population in southeastern China.

Dr. Li applies a new and a very ingenious method in his study of the expansion of the "We-group" by correlating it with the spread of walled cities, one of the cultural traits by which it has always been especially characterized. Another new method is an investigation of the origin and spread of surnames. With the gradual breakdown and eventual complete overthrow of the ancient feudal system, during the latter half of the first millennium before the Christian era, the use of surnames, together with the ancestor worship once the exclusive privilege of the nobility, spread among the common people. The consequence has been the recording of an enormous amount of genealogical material, kept with scrupulous care, for upon its accuracy was believed to depend the welfare both of the living and of the dead.

The tale of the migration of the "We-groups" is carried still further by an analysis of the census figures given in the official dynastic histories of China. Allowance is made for inaccuracies and inconsistencies; but it is pointed out that at least two things may be taken for granted: (1) that they indicate with tolerable certainty the relative density of the population; and (2) that they always represent the distribution of the "We-group." A regional study then shows that the Chinese population about the beginning of the Christian era was concentrated mainly in the northeastern and east-central portions of China proper, the rest of the country containing less than a fourth of the total number. Since that time, according to Dr. Li, there has been a steady decrease in the regions just named, coupled with an almost phenomenal growth south of the Yangtze River. This cannot be accounted for as a result of natural increase alone but must have been due to a steady stream of immigration also. As a result of immigration, especially during the T'ang Dynasty (roughly the seventh to ninth centuries of our era), much of the south was first definitely incorporated into the Chinese culture group. The geographical factors by which the direction of these migratory movements was controlled are also described.

The size and racial constituents of the southern "You-groups" are considered. The ethnic composition of these and particularly of the strong and comparatively civilized Yangtze Valley states, from the Red Basin of Szechwan right down to the sea, offers one of the most important and at the same time fascinating problems encountered in the study of the early historical development of China. For not only were these states eventually absorbed by the true Chinese civilization of the north, but in the process, as is steadily becoming more and more apparent, they strongly influenced the latter in many and fundamental ways. Dr. Li begins this discussion

with an interesting account, compiled from ancient Chinese sources, of the various aboriginal tribes of southeastern China, and of the presence of Negritos in that region as late as the third century of our era. It is impossible to give details here; but practically all the traits recorded of these "southern barbarians" by the careful and conscientious Chinese observers of many centuries ago are to be found surviving today among groups now dwelling much farther to the west and southwest, in Indo-China.

But, in addition to their contacts with the southern aborigines, the Chinese people have also been strongly influenced by invasions from the north, by Turkic, Mongolic, and Tungusic stocks. These are described from material found in the Chinese historical sources. Northern China has suffered frightfully, through long centuries, from Tatar invasions far more severe and extensive than those of the Huns, Avars, Magyars, Mongols, and others which occasionally penetrated into central and even western Europe.

Between the contacts of the Chinese with the southern and with the northern "You-groups" there was, however, this difference. In the former case the Chinese have been mainly the aggressors, imposing themselves upon a settled and agricultural people whose culture in turn definitely influenced that of their conquerors. In the latter the Chinese have usually, though not invariably, been the victims, but have in the long run almost completely assimilated their invaders. The struggle with the latter was a severe one, and the Chinese have more often than not been the losers in a political sense; but they have invariably been able, through their vastly greater numbers and higher degree of civilization, to absorb their conquerors.

In conclusion Dr. Li gives a summary of the ethnic elements contributing to the racial composition of the modern Chinese. He shows how the "We-group" has been gradually enlarged, not merely through its own internal multiplication but by the incorporation of various external elements, mainly aboriginal in the south but intrusive in the north. This is made clear by numerous tables showing the proportions in which the combinations occur and giving the physical traits, as far as they have been made out, of the constituent elements.

C. W. Bishop

Abbé Huc's Classic Narrative

Huc and Gabet. **Travels in Tartary, Thibet, and China, 1844–1846.** Transl. by William Hazlitt; now edited with an introduction by Paul Pelliot. Vol. 1, xliv and 387 pp.; map. Vol. 2, viii and 406 pp.; index. (The Broadway Travellers.) Harper & Brothers, New York and London, 1928. $10.00. 9 x 6 inches.

Professor Pelliot, in his scholarly introduction to the Abbé Huc's narrative of travel, says rightly that the book owes its perennial interest chiefly to the literary gifts of its author. Huc knew uncommonly well how a tale should be told. He wrote easily, had a lively imagination coupled with a strong feeling for the dramatic, and was also a keen observer.

On the other hand he was nearly devoid of a historical sense. Nor was he above manipulating his materials for the sake of effect. We need not recapitulate the arguments so ably set forth by Professor Pelliot in his introduction and elsewhere to show that, in starting out, Huc and his ecclesiastical superior, Gabet, had no such predetermined plan of going to Lhasa as the former asserts. Professor Pelliot sums up the case thus: "All these texts show clearly enough that the Lazarists' instructions sent them to the North-West into Outer Mongolia, to the Khalkha country, towards Urga, and that we must attribute to a combination of fortuitous circumstances the changes in the itinerary which, leading them to the South-West, eventually brought them to Lhasa."

The Abbé's descriptions are delightful; and he plunges into them almost at once.

Thus his account of "Tartary" (here Inner Mongolia): "There are no towns, no edifices, no arts, no industry, no cultivation, no forests; everywhere it is prairie, sometimes interrupted by immense lakes, by majestic rivers, by rugged and imposing mountains; sometimes spreading out into vast limitless plains. There, in these verdant solitudes, the bounds of which seem lost in the remote horizon, you might imagine yourself gently rocking on the calm waves of some broad ocean. . . .

"You sometimes in Tartary come upon plains more animated than those you have just traversed; they are those, whither the greater supply of water and the choicest pastures have attracted for a time a number of nomadic families. There you see rising in all directions tents of various dimensions, looking like balloons newly inflated, and just about to take their flight into the air. Children, with a sort of hod at their backs, run about collecting *argols*, which they pile up in heaps around their respective tents. The matrons look after the calves, make tea in the open air, or prepare milk in various ways; the men, mounted on fiery horses, and armed with a long pole, gallop about, guiding to the best pastures the great herds of cattle which undulate, in the distance all around, like waves of the sea."

Huc's narrative of his own and Gabet's crossing of the Land of Grass, the flooded Yellow River, and the steppe block of the Ordos, and of their passage through part of Kansu and the Alashan, is full of interest. The incidents described perhaps did not always occur quite as they are set down; but they are just the sort of thing that might and should have happened. His account of their long residence at the great lamasery of Kum-bum, near the Kôkô-nôr, or "Blue Sea," although probably very far from explaining the real reason for their stay there, is one of the most entertaining portions of the book. He depicts the great caravan of the Tibetan embassy returning from Peking, which they accompanied to Lhasa, and gives an equally fine description of his first sight of Lhasa.

In Huc's account of their expulsion from Tibet, his dislike for the Chinese crops out again and again. He altogether fails, or perhaps never attempts, to appreciate their side of the question; and he can see in them neither generosity nor magnanimity.

In spite of undeniable faults, some of which have been pointed out, Huc's narrative is throughout vivid, graphic, and full of local color and human interest. And, while it may not always be strictly true to fact, it is in most ways very true to life and has afforded pleasure and instruction to generations of readers.

C. W. Bishop

A Famous Travel Narrative of the Seventeenth Century

Memorable Description of the East Indian Voyage, 1618–25, by Willem Ysbrantsz Bontekoe. Translated from the Dutch by Mrs. C. B. Bodde-Hodgkinson and Pieter Geyl. With an Introduction and Notes by Professor Geyl. vii and 168 pp.; ills., index. (The Argonaut Series.) Robert M. McBride & Co., New York, 1929. $4.00. 9 x 6 inches.

Geographical lore of bygone days is admirably laid before the twentieth-century student in the Argonaut Series (called "Broadway Travellers" in the English edition) edited by Sir E. Denison Ross, Director of the School of Oriental Studies and Professor of Persian in the University of London, and Dr. Eileen Power, Reader in Medieval Economic History in the same institution. The English reader has here in convenient form texts hitherto untranslated and reprints of narratives long since out of print or practically unprocurable.

In this instance there is presented for the first time in English a record of the struggles and escapes that fell to the lot of a Dutch sailor from Hoorn (the same town that gave name to the Cape rounded by Le Maire and Schouten in 1616). Bontekoe was in the East from 1618 to 1625, but his story was not printed until 1646. When it did appear it ran through fully a dozen editions in the seventeenth

century and has been reprinted down to our own times, the Maatschappij der Nederlandsche Letterkunde te Leiden choosing it for the first of its series of reprints in 1915. It was translated into French for Thevenot's and Renneville's collections of voyages and into German for the series edited by Schwabe; but, strange to say, the Hakluyt Society and other English compilers have passed by or have overlooked this moving tale.

Bontekoe set sail from the Texel on December 28, 1618. May saw him round the Cape of Good Hope, then came a month at Réunion and Madagascar for rest and recuperation of men down with scurvy. Once more at sea he headed for Java, and things went well until the ship caught fire on November 19 and was lost. After desperate efforts the survivors finally managed to make land two weeks later not far from Sumatra, whence they reached Batavia. Two comparatively uneventful years followed in voyages from one island to another, carrying stone for the new fort at Batavia, fetching spices and pepper and food and supplies—anything that came in the day's work. In 1622 Bontekoe served for two years as captain of one of the ships attacking the Portuguese at Macao, which meant constant fighting with little advantage and less credit for either side but with adventure enough on sea and land. In February, 1625, he sailed for home from Batavia and landed at Zeelandt on November 16, just a month less than seven years after he had set forth.

Much of the book is little more than a transcript of his logs, but here and there come amusing touches that enliven the reading. The translating has been done better than the editing. For instance, we are given what is said to be the "Title Page, edition of 1646," but really find it a translation; mention is made of the Dedication by Deutel, the printer, but nothing is said about the sonnets and other verses prefixed to the original. The illustrations are all reproduced, but they have lost sadly by reduction.

HARRY MILLER LYDENBERG

SOUTH AFRICAN SOIL MAP

Official Soil Map of the Union of South Africa, with Explanation Compiled in the Office of the Soil Survey. 12 pp., map. *Union of South Africa, Dept. of Agric. (Div. of Chemistry Ser. No. 94) Sci. Bull. No. 79.* Pretoria, 1929.

The map covers the whole of the Union of South Africa on a scale 1:3,000,000. Agreeing with the soil map of Africa by C. F. Marbut (scale 1:25,000,000, *Amer. Geogr. Soc. Research Ser. No. 13*, 1923, Pl. 1) in the broadest essentials, the map shows considerable refinement in the 53 soil types into which the 9 provinces are divided. Soil provinces are distinguished by contrasting but not displeasing colors. Boundaries and key numbers of the subdivisions unfortunately are in a faint overprint difficult to read. Criteria for delineating the boundaries of the soil provinces include: "climate, topography, geology, agricultural practices, and potentialities," although emphasis seems to be placed upon the soil color and agricultural utilization. Division of the much generalized soil provinces into fifty-three soil types localizes the soil picture of South Africa into units as small as 600 square miles, although the average for each type is larger. Basis for the subdivision into soil types is primarily upon texture, although color and soil profile are also taken into account. Streams and elevations above three thousand feet are shown on the map, so that one may detect a relationship between the soil type boundaries and these physiographic features. The accompanying explanation gives a generalized description of each soil province and a more complete description of the types including distribution, character, topography, type of veld, agricultural activities, and agricultural products in tabular form.

From a physical standpoint "there are all types of soils ranging from gravels to very heavy clays," some averaging more than 50 per cent clay. Chemically the soils are deficient in nitrogen, phosphates, and humus, although the nitrogen content is

adjudged adequate in proportion to the water content. In the more arid sections, the Great and Little Karroos and western and southwestern Orange Free State, the soils are cursed with the presence of brak in the surface or substrata which renders them sterile to agriculture. Indeed, much of the flood water originating in this section becomes charged with sodium carbonate, present in the soil, by which its value for irrigation purposes is decreased. Generally the best soils are found in the well-watered central, southern, and eastern Transvaal, in the eastern and central Orange Free State, and in the coastal section of Natal. An intensive agricultural development occurs in the southwest coast section of the Cape Colony, where, however, the soils are "patchy" and necessitate considerable use of fertilizers. The most intensive development occurs on the heavy alluvial loams of the stream valleys where the soils are deep and fertile.

R. B. Frost

The Coal Industry and World Production and Trade

The Problem of the Coal Industry: Interim Report on its International Aspects by the Economic Committee of the League of Nations. 49 pp. *League of Nations Publs., Economic and Financial Section, II, 19*, Geneva, 1929.

Memorandum on Production and Trade 1913 and 1923–1927. 79 pp. *League of Nations Publs., Economic and Financial Section, II, 13*, Geneva, 1929.

As a result of the disturbed condition of coal mining that has been general throughout the European producing countries since the World War, the Economic Committee of the League of Nations was directed in 1928 to make a study of the industry. The Committee has not completed its investigation, but in 1929 an interim report was published. The most valuable part of the report to the geographer is the statistical appendix containing concise tables showing the production of coal, coke, and lignite for all of the countries of the world for the years 1920 to 1928 with columns for 1913 and an average for 1909–1913 added for comparison, tables of consumption by countries, and tables of the international trade in coal showing both imports and exports by countries.

Though the present publication is only a preliminary report, it gives an excellent survey of the difficult economic problems of the industry. It is based upon the examination of a number of experts from the European coal-producing countries. It was brought out in the investigation that the fundamental difficulty of the industry is the very wide margin that exists between the producing capacity of the world's coal mines and the demand for coal. It is a situation that has arisen with the great stimulation of mining activity during the World War not only in the leading producing countries but in countries such as Holland, Spain, Japan, and India that were temporarily cut off from their usual sources of supply by the disruption of world trade. It has been aggravated by the great improvements in technique and in the use of machinery in the mines, especially in Belgium and France, and by the increasing dependence upon oil and hydro-electric energy. The extent of the margin of surplus capacity was evidenced by the ease with which the total world output was kept constant in 1923 despite the cutting off of the supplies from the Ruhr and again in 1926 at the time of the British coal strike.

The overproduction that has resulted inevitably from the surplus capacity has forced the producing countries to enter into strenuous competition for world markets, and prices have been depressed. Mines have been closed down, and there is serious unemployment in the industry. Countries that formerly imported most of the coal for their industries and for their transportation systems have erected tariff barriers to safeguard their newly opened mines.

Though the Committee in the present report makes no specific recommendations for the regulation of the industry, the discussion of the various proposals put forth

by the experts indicates how completely the ills of the coal industry have become an international problem. Any effort of an individual country to end overproduction through the curtailment of its own output will necessarily be futile, since it will stimulate other countries to increase their production. It seems evident that any sound remedy to be effective must be based upon international action of some sort. The most promising proposal is the organization of an international coal committee representative of all interests—governments, employers, miners, merchants, and consumers—charged with the formulation of the international agreements that are required for the rehabilitation of the industry.

Of somewhat more general interest is the "Memorandum on Production and Trade." The first Memorandum was published in 1926 as one of the preparatory documents for the World Economic Conference, and the second in 1928. The present publication, the third in the series, brings the indices through 1927 with some preliminary data for 1928. It follows, in the main, the form of the previous reports. The first chapter is an analysis of world population growth since 1913, the second of the production of the more important raw materials and foodstuffs, the third of the growth of world trade, and the final chapter of the changes that have occurred in the prices of crude products and manufactured articles.

The classification of the data is by continents and large sections of continents, and for that reason the Memorandum loses some of its possible value since it provides no material for the study of specific countries. There is a detailed classification by commodities, however. No absolute data are included, but by the use of relatives —index numbers and percentage distributions—the striking changes that are occurring in the trends of population growth and production are indicated. The Memorandum is filled with facts of significance to the geographer. It would appear, for example, that the production of food and raw materials is at present more than keeping pace with the increase in population. The tables of relatives also show, perhaps more clearly than would the absolute data, the commanding position of Europe and America in the production of the basic materials of manufacture, notably coal, pig iron, and steel. The Memorandum is particularly valuable for the quick determination of the general changes that may be occurring either in the rate of production of a commodity or in its sources.

JOHN E. ORCHARD

MIGRATION STATISTICS

IMRE FERENCZI. **International Migrations,** Vol. I: Statistics. 1112 pp.; diagrs., bibliogr., index. (Publs. Natl. Bur. of Econ. Research Inc., No. 14.) New York, 1929. $10.00 9 x 6½ inches.

Nine hundred pages of this book are occupied by migration statistics. They have been assembled and analyzed not merely for the purpose of review, valuable as this may be, but also "to facilitate the future development of uniform statistical methods in all countries." The first annual statistics of migration had to be located; methods of comparison had to be established (or supplementary sources searched out); and, finally, there had to be made a technical study of the statistics of each country in order to estimate their value at different periods.

The two most valuable chapters from the geographical standpoint are those entitled "General Introduction to the Historical Survey," a short account of less than three pages, and "Proletarian Mass Migration, XIXth and XXth Centuries," a chapter of seven pages. These two chapters review the changes in migration types or waves, the economic and political conditions back of the principal migration movements from the old world to the new, and the incentives in the lands of immigration which impelled such vast numbers to leave home. In the period 1820 to 1924 the oversea countries of immigration received fifty-five and a half millions of persons. In the first half of the nineteenth century the migrants came principally

from Great Britain and Germany. In that period the movement was determined mainly by economic, political, and religious conditions in European countries, which were so bad that the high cost of the journey and the hard life on board ship did not prevent the movement from reaching large proportions. "It was not uncommon for 1 to 10 per cent of the emigrants to perish either on board ship or soon after landing." The increased use of machinery and cheap raw material from overseas resulted in an increase of European population which in turn, through emigration, provided labor for oversea territories; and the number of emigrants was increased by the impoverishment of European agriculture.

In the latter half of the past century transport facilities have improved amazingly in comfort, cost, and speed. The tremendous amount of available new land in the United States, our liberal agrarian legislation, and the rapid growth of our large-scale industries conspired to offer increasing advantages when compared with other receiving countries, with the result that our land was rapidly filled up nearly to the point of saturation. This and the further impoverishment of Europe as a result of the World War and its impetus to mass emigration brought into being present restrictive measures which have been applied not only by the United States but also by most European countries.

Some Elementary Meteorologies

C. E. P. Brooks. **The Weather: An Introduction to Climatology.** 79 pp.; diagrs., bibliogr. (Benn's Sixpenny Library, No. 145.) Ernest Benn Ltd., London, 1928. 6d. 6½ x 4 inches.

David Brunt. **Meteorology.** 112 pp.; maps, diagrs., ills., bibliogr., index. (The World's Manuals.) Oxford Univ. Press, American Branch, New York, 1928. $1.00. 7½ x 5 inches.

W. H. Pick. **A Short Course in Elementary Meteorology.** 2nd edit. revised. 127 pp.; maps, diagrs., ill., bibliogr., index. *Meteorol. Office Publ. No. 247*, London, 1926. 1s. 6d. 9½ x 6 inches.

Eugene Van Cleef. **The Story of the Weather.** xii and 274 pp.; maps, diagrs., ills., bibliogr., index. Century Co., New York and London, 1929. $2.50. 7½ x 5 inches.

E. E. Free and Travis Hoke. **Weather: Practical, Dramatic and Spectacular Facts About a Little Studied Subject.** With maps and drawings by Elise Seeds. Robert M. McBride & Co., New York, 1928. 337 pp.; maps, diagrs., ills., bibliogr., index. 9 x 6 inches. $3.00.

Our British friends have produced a graded series of elementary books in meteorology that Americans might well more widely enjoy. The examples used, however, are mostly unfamiliar to us. Brooks's "The Weather" is a remarkably comprehensive summary of meteorology, considering its small size. As the title indicates, it provides an introduction to climatology, in which field the author has published several books, the best known being "Climate Through the Ages" and "Climate: A Handbook for Business Men, Travellers and Students." Four of the seven chapters are on weather: The Sun and the Atmosphere; The Way of the Winds; The Conditions in the Upper Air, and Cyclones and Anticyclones. The rest of the booklet treats of Climatic Zones, The Climates of the Continents, and Local Modifications of Climate. Neither accuracy nor readability has been sacrificed to brevity.

Brunt's success in squeezing meteorology into a small popular manual is also noteworthy. Besides giving more detailed and well illustrated treatments of those phases of meteorology discussed by Brooks, the author brings in a brief summary

of meteorological history, describes the standard meteorological observations and their use, and the variation of temperature in the atmosphere and some of its physical effects. The modern conceptions of storms are clearly and comprehensively covered in four chapters. The illustrations are well chosen and finely reproduced. This is probably the best small manual of meteorology in English, both for scientific accuracy and popular interest—an all too rare combination.

The third book, Pick's "Short Course in Elementary Meteorology," is all that its title implies. It is sufficiently comprehensive to be called a course, though a short one; and it is real meteorology, though elementary. No better recommendations of it could be made than (1) that it was written by a teacher of meteorology for a class of students learning meteorology as a profession; (2) that it is published by the British Meteorological Office, with an appreciative preface by Director G. C. Simpson, (3) that it has successfully stood the test of nearly a decade, having run into a second printing of a revised edition, and (4) that it is being used as a textbook in the Central Office, U. S. Weather Bureau. The book consists of three parts: General Meteorology, about half the book, Synoptic Meteorology, one third, and the Upper Air, the remaining sixth. The treatment of general meteorology begins with an introductory note on the atmosphere and the value of meteorology especially to the airman. Winds follow. Though, almost without exception, the author is careful not to omit important steps in his reasoned explanations of meteorological phenomena, his treatment of local winds is inadequate. Errors are few, however, and are more than balanced by the clear descriptions of difficult physical processes. For example, the author's account of the nature of evaporation and of vapor pressure (after Simpson) is a joy to read.

In "The Story of the Weather" Professor Van Cleef presents in popular form "the weather as an organized unit of nature" and discusses effects of the weather on man and various phases of his endeavor. The popularized meteorology of the first two-thirds of the book, while calling for considerable criticism from the standpoint of scientific accuracy and up-to-dateness (compare *Bull. Amer. Meteorol. Soc.*, Vol. 11, 1930, pp. 23–24) is, nevertheless, very readable and interesting and is skillfully combined with the human outlook on the weather. The last third of the book is devoted directly to human aspects of weather and climate. Here "Weather, Climate, and Business" is the outstanding chapter of the book. Its topics are: Capitalizing the weather; advertising in local, national, and international trade; construction work; efficiency of labor; weather indoors; Chamber of Commerce literature. The next chapter, "The Weather and Our Homes," includes valuable suggestions to anyone about to build, remodel, or simply improve his house—as to making the most of applied weather knowledge.

The book by Free and Hoke is a breezy and in some ways successful attempt by non-meteorologists to tell people what they want to know about weather. There is a freshness of approach and an up-to-dateness born of wide reading of modern meteorology that is not always found in books by weather men. On the other hand, one misses the ripeness of the meteorologist's judgment on certain questions. Along with the excellent summaries of some phases of meteorology and climatology comes more than a sprinkling of dogmatic, unscientific positiveness and of overcautious inconclusiveness. One finds that meteorology as a science has been allowed to suffer for the dramatic, even the melodramatic, and spectacular, as witness the following: "For more than nine-tenths of the earth's lifetime there seems to have been no such thing as weather" (p. 15); "The sky is almost terrifying, seen from the top of a high mountain or from a plane three or four miles up in the air. Instead of the accustomed blue, one stares into a pall of black—a dead, oppressive black even at noon" (p. 229); "Temperatures of 130 degrees in Death Valley are almost comfortable, so dry is the air" (p. 290).

The numerous illustrations, both photographic and diagrammatic, are well chosen. Miss Seeds's impressionistic or jazzy diagrams and maps carry their general point but, at times, not without considerable inaccuracies that even their sketchiness should hardly excuse; for example, the prevailing-wind map (p. 209), which shows southeasterly winds for the western two-thirds of the North Atlantic steamer lane!

For the reader who wishes a modern colloquial view of meteorology and who does not mind a long bow now and then, this popular book by Free and Hoke will give an interesting summary of the subject with considerable emphasis on its applications and further applicability in everyday life.

CHARLES F. BROOKS

A HANDBOOK OF CLIMATE

C. E. P. BROOKS. **Climate: A Handbook for Business Men, Students and Travellers.** 199 pp.; maps, diagr., bibliogrs., index. Ernest Benn Limited, London, 1929. 10s. 6d. 8½ x 5½ inches.

From its original publication, in 1883, Hann's "Handbuch der Klimatologie" has been the world's standard text and reference book on climatology. Köppen's excellent volume, "Die Klimate der Erde" (1923), to a certain extent bridged the gap that developed after the publication of the third and final edition of the Hann "Handbuch" (1908–1911), and it should be noted that the forthcoming Köppen-Geiger volumes will furnish a complete and thoroughly up-to-date reference book on climate (see *Bull. Amer. Meteorol. Soc.*, Vol. 9, 1928, pp. 94–97). But the situation of the non-German-reading student was for long unfortunate. It was greatly relieved in 1922 when W. G. Kendrew's "The Climates of the Continents" appeared, founded, inevitably, upon Hann's masterwork; and the publication of a second edition in 1927 testified to its deserved success.

As the latest contribution to general climatological literature in English we welcome very heartily the volume entitled "Climate" by Dr. C. E. P. Brooks, Superintendent of the General Climatological Division of the Meteorological Office in London. Here, in 200 pages, we have information concerning the world's climates that will probably serve the needs of many of "the business men, students and travellers" for whom the book was planned. We cannot, however, refrain from expressing the hope that most students will wish to seek fuller information than this book contains.

The arrangement of the text is by the climatic zones, these being modified, where necessary, by continental or political boundaries. The successive chapter headings are as follows: The North Temperate Regions; "Mediterranean" Climates (from which, curiously enough, the climate of southern California is omitted); North Tropical Climates; Equatorial Climates; Sub-tropical and Temperate Climates of the Southern Hemisphere; The Polar Regions. The scheme has led to some rather striking incongruities though it simplifies the use of the volume for reference purposes by most general readers. At the end of each section the essential climatic data are tabulated for ten selected stations. For each station there are given the situation (coast, inland, island, etc.); the latitude and longitude; the altitude above sea level (in feet); and the number of years of the record. We commend very heartily Dr. Brooks's tables as being short, compact, and distinctly helpful.

In a small book such as this we cannot expect any lengthy explanations, or first-hand descriptions emphasizing the human element, which always contribute so much towards giving life and interest to "dry" climatic statements. We regret the almost complete absence of charts and diagrams. The small size of the volume and the desire to keep the cost low are given as the reasons for this situation. Nevertheless, diagrams and maps serve a very useful purpose and save a good deal of descriptive text. And they certainly simplify the text discussions.' Adequate bibliographies are included at the end of each section.

R. DEC. WARD

The Quaternary Ice Age

Paul Woldstedt. **Das Eiszeitalter: Grundlinien einer Geologie des Diluviums.** xv and 406 pp.; maps, diagrs., ills., bibliogr., index. Ferdinand Enke, Stuttgart, 1929. 6½ x 9½ inches.

This work, dedicated to Felix Wahnschaffe, Albrecht Penck, and Frank Leverett, is a survey of the present knowledge of the Quaternary Ice Age on the entire earth and, as such, fills a big gap in glaciological literature. James Geikie's "The Great Ice Age" (1874, 1877, and 1894) is long since entirely out of date. W. B. Wright's inspiring book, "The Quaternary Ice Age," was published in 1914.

After an introductory treatment of modern glaciers and ice sheets, Woldstedt's book continues with six chapters which examine in detail the problems of erosion of the Pleistocene ice sheets and of their deposits, formations immediately outside the glaciated areas, interglacial and interstadial deposits, and of flora and fauna during the Ice Age. Then follows a regional treatment; and, finally, man during the Ice Age, changes of level, climate and causes of ice ages are introduced for discussion. The problems are viewed from many angles and are based on a wealth of information. While emphasis, naturally, is laid on the author's own land, Germany, he has taken commendable pains to familiarize himself with the entire world literature of the subject; and he has a personal acquaintance with the three most important areas of Pleistocene glaciation—northern Europe, the Alps, and North America. Discussions and conclusions are characterized by wide knowledge and good judgment, but the author's tolerance is perhaps occasionally too broad. For instance, some of the "ideas" and "theories" on the cause of ice ages had better have been omitted or treated according to their questionable merits.

"Das Eiszeitalter" is *the* present standard work on the subject. The reliable and useful qualities mentioned are supplemented by an excellent set of pictures, maps, profiles, graphs, and tables, a long bibliography, an index, and a beautiful appearance.

Ernst Antevs

Physical Oceanography

H. A. Marmer. **The Sea.** x and 312 pp.; maps, diagrs., ills., index. D. Appleton & Co., New York and London, 1930 $3.00. 8 x 5½ inches.

The increasing importance of the oceans does not depend only on their use as highways for commerce and travel and as important sources of food. There is increasing evidence of their fundamental influence on the climate and weather of the earth as a whole. Moreover, the various oceanic and atmospheric motions and other processes proceed in accordance with definite physical principles, toward the comprehension of which we are making encouraging progress. However, the general reader knows relatively little about the sea, and there is need of appropriate non-technical writings. "The Sea" by Marmer is a most welcome contribution to this field. This book, the product of years of careful work based on a lifetime's study and research by the author, brings the science of oceanography within reach of the general reader.

The bewildering diversity of topics falling under the comprehensive title compels elimination and selection. The author has wisely focused attention upon the water itself, thus gaining unity of treatment of a basic part of the whole subject. Only passing mention is made of such topics as the geology of the ocean basins, the bottom deposits, sedimentation, coast erosion and deposition, and marine life. Even with this limitation the book tends to be encyclopedic in character though the author's skill in coördinating the various phenomena and explaining the underlying theories keeps it from being a mere catalogue of facts. Interest is also maintained throughout by showing the bearing of the various topics on human affairs. The progress of

the human race from ancient times is closely associated with advances in knowledge of the earth, including the ocean and the atmosphere. The interesting historical account presented in the first quarter of the book shows well the fundamental part played by the sea in affording correct geographical knowledge and in the distribution of population. The author reveals the broadening influence of these discoveries on thought in general, resulting in revolutionary changes in man's point of view.

In the last three-quarters of the book is an elementary exposition of physical oceanography including ocean depths and methods of measuring them, waves, tides, ocean currents, the distribution of temperature and salinity, and the physical properties of sea water. Special attention is given to the phenomena of freezing and thawing and their effects on the amount of solid matter in solution. The author's treatment of these essentially quantitative topics is presented in plain language. Except for a few simple formulae used in the subjects of waves and tides, the treatment is non-mathemacical.

Special attention is given to the Gulf Stream because it has been studied in greater detail than any other ocean current and because it has remarkable characteristics and far-reaching effects. In the concluding chapter the author defines oceanography and, by illustrating the fomulation of certain problems, shows how it is becoming an organized body of knowledge fully entitled to be called a science.

The author is to be congratulated on producing a work of such interest in a field familiar only to the few who have had special opportunities for study and research. I heartily recommend his book to all interested in a popular but authoritative survey of physical oceanography, including its vital relation to human affairs from the earliest times to the present.

GEO. F. MCEWEN

AERIAL PHOTOGRAPHS OF HOLLAND AND JAVA

The Importance of Holland Seen from the Air. 139 pp.; ills., index. Royal Dutch Air Lines, Holland, [1928?]. 12¼ x 10 inches.

H. M. DE VRIES, edit. **The Importance of Java Seen from the Air.** 332 pp.; maps, diagrs., ills. G. Kolff & Co., Batavia, [1928?]. 12 x 10 inches.

The interesting album "The Importance of Holland Seen from the Air" has been produced by commercial interests in the Netherlands with the coöperation of the Royal Dutch Air Lines. It resolves itself into a topical description of the outstanding factories of the country and enables one, since each description is accompanied by an aerial photograph, to form a comprehensive picture of the industrial life of the country. One notes the large number of industrial centers completely surrounded by the typical rectangular fields of the country areas.

Similarly the state railways, municipalities, and private concerns have coöperated with the military air force in producing "The Importance of Java Seen from the Air." The method is particularly useful in depicting the entire economy of the plantations. The large sugar mills and attendant settlements are surrounded by the flat irrigated fields; the buildings of the coffee and tea estates, each a community in itself, are set down in the midst of field after field of trees; on the rubber plantations the buildings are almost lost in a sea of trees untidy in effect compared with the neatly ordered rows of the tea and coffee plantations. There are views of native agriculture on the small terraced plots along the steep slopes of the valleys. With the view of the agricultural activities of Java the companion pictures of the urban centers with their extensive industrial and transportation facilities take on added significance.

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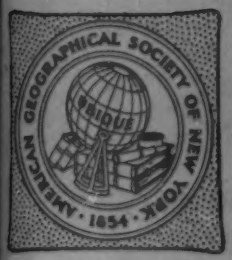

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OUR CONTRIBUTORS

SIR DOUGLAS MAWSON is professor of geology and mineralogy in the University of Adelaide. He was initiated into Antarctic exploration as a member of the British Antarctic Expedition, 1907–1909, under Shackleton. This was followed by the Australasian Antarctic Expedition, 1911–1914, of which he was leader and of which he has given a general account in "The Home of the Blizzard," 1915. To "Problems of Polar Research" (*Amer. Geogr. Soc. Special Publ. No. 7*, 1928) he contributed a paper on "Unsolved Problems of Antarctic Exploration and Research."

CAPTAIN RIISER-LARSEN had acquired fame as an aviator of the Norwegian Navy when he was invited to participate in the Amundsen-Ellsworth Polar Flight of 1925. To the narrative account of this expedition he contributed a chapter on "The Navigator's Task." He proved himself equally skillful in handling an airship the following year when he navigated the *Norge* in the first crossing of the Polar Sea. To the narrative of this expedition also he contributed a chapter on "The Navigation over the Polar Sea."

DR. MCBRIDE, formerly librarian of the American Geographical Society, is now head of the department of geography in the University of California at Los Angeles. Dr. McBride, who has spent many years in Latin America, has just returned from Chile, where he has been studying the land system of the country under the auspices of the University of California and the American Geographical Society. He is the author of "The Agrarian Indian Communities of Highland Bolivia" (1921) and "The Land Systems of Mexico" (1923).

MR. WILLCOX is associated with Pan American Airways. As a civil engineer he has traveled in various parts of the world, including little-known parts of Colombia and Venezuela. To the *Geographical Review* he contributed the article "An Exploration of the Rio de Oro, Colombia-Venezuela" (July, 1921).

DR. MATHIASSEN, of the National Museum, Copenhagen, was a member of Dr. Knud Rasmussen's Fifth Thule Expedition to Arctic North America in the years 1921–1923, where he was in charge of the excavations, studied the recent Iglulik Eskimos, and mapped a considerable part of Northern Baffin Land. Of his final reports on these results there have appeared: "Archaeology of the Central Eskimos," I–II (1927), "Material Culture of the Iglulik Eskimos" (1928), and "Archaeological Collections from the Western Eskimos" (1930).

DR. FLINT is assistant professor of geology in Yale University and a member of the Connecticut Geological Survey. During recent years he has made a study of the glaciation of southern New England. On this subject he contributed to the *Geographical Review* (April, 1929) "The Stagnation and Dissipation of the Last Ice Sheet." The present paper is published through the courtesy of the Connecticut Survey.

MR. WATSON, now of the Massachusetts Institute of Technology, has lately been assistant curator of the New Bedford Whaling Museum. He is the author of "The Long Harpoon," a collection of historical papers on whaling.

DR. BOGARDUS is assistant professor of geography at the University of Pennsylvania.

DR. CRESSEY, now of Clark University, has for a number of years been professor of geology and geography at Shanghai College. His book on the geography of China is now nearing publication.

MR. STEFANSSON is best known for his journeys in and studies on the Arctic and especially for his work as leader of the Canadian Arctic Expedition, 1913–1918. Among his books are "My Life with the Eskimo" (1913), "The Friendly Arctic" (1921), "The Northward Course of Empire" (1922). He has contributed several papers to the *Geographical Review*, and to "Problems of Polar Research" the paper "The Resources of the Arctic and the Problem of Their Utilization."

DR. KARPINSKI is professor of mathematics at the University of Michigan. During the year 1926–1927 he arranged for the photographing of manuscript maps relating to America in French, Spanish, and Portuguese archives. He has done considerable work on the maps of Michigan for the Michigan Historical Commission.

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The American Geographical Society is the oldest geographical society in the United States. When it was founded, in 1852, there were but twelve similar societies in the world. Now it exchanges publications with more than four hundred scientific associations. The Society publishes the *Geographical Review*, a quarterly magazine issued in January, April, July, and October, and a *Research Series* of comprehensive scope. It has also a large and growing library—one of the most important geographical libraries of the world; thousands of maps and charts; and a remarkable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries.

Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the book and map collections.

Three gold medals have been founded by the Society, the *Cullum Geographical Medal*, the *Charles P. Daly Medal*, and the *Samuel Finley Breese Morse Medal*, which are awarded from time to time to explorers, writers, and men of science who have contributed to the advance of geographical knowledge.

In addition it awards the *David Livingstone Centenary Medal*, founded by the Hispanic Society of America.

The qualifications for fellowship are an interest in exploration and travel, in the spread of geographical knowledge, and in the advancement of science.

A Fellow is entitled to the use of the library, reading and map rooms; to admission to all lectures and exhibitions; to the *Geographical Review;* and to occasional books and maps distributed by the Society.

The annual dues are ten dollars.

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